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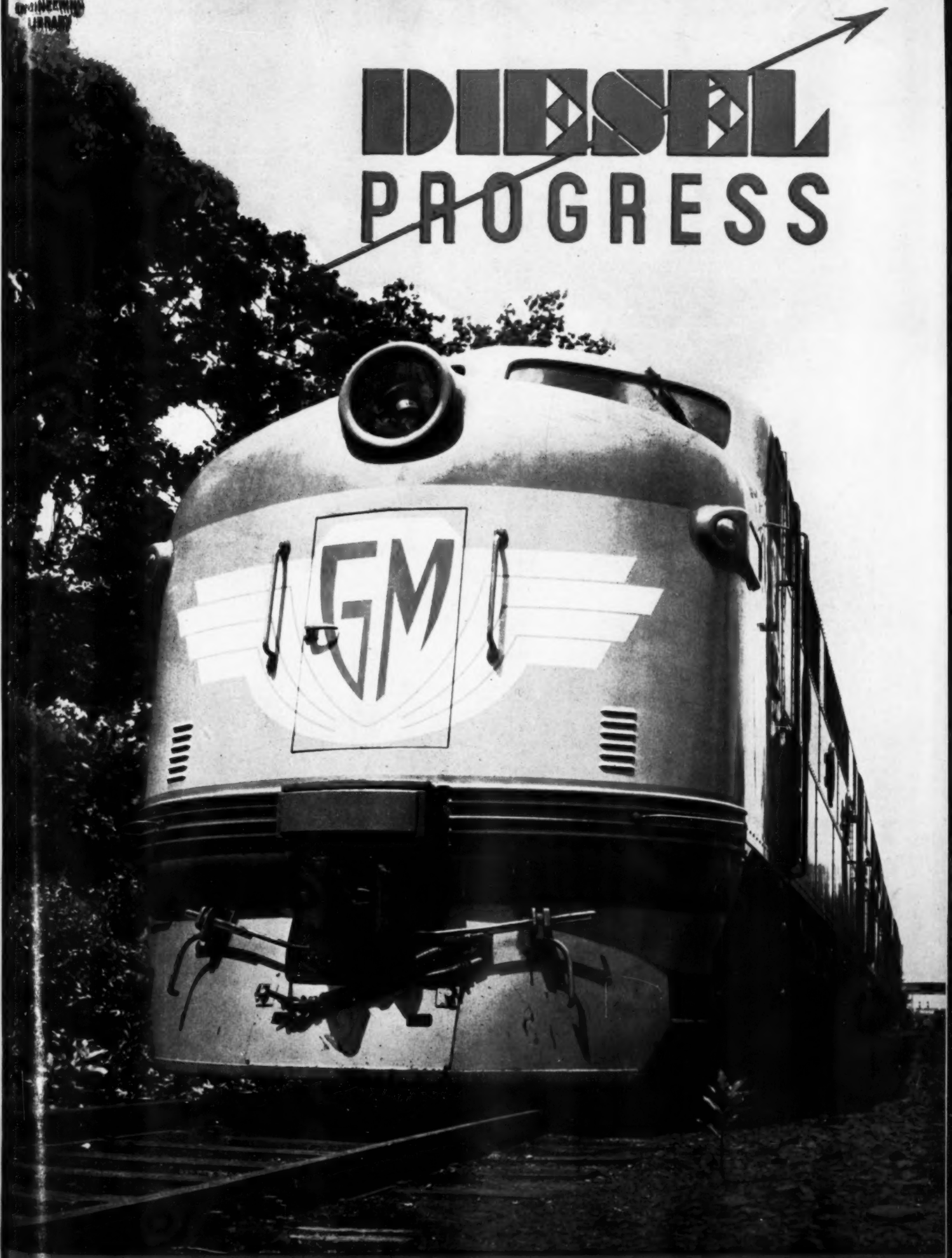

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DIESEL and GAS ENGINE PROGRESS

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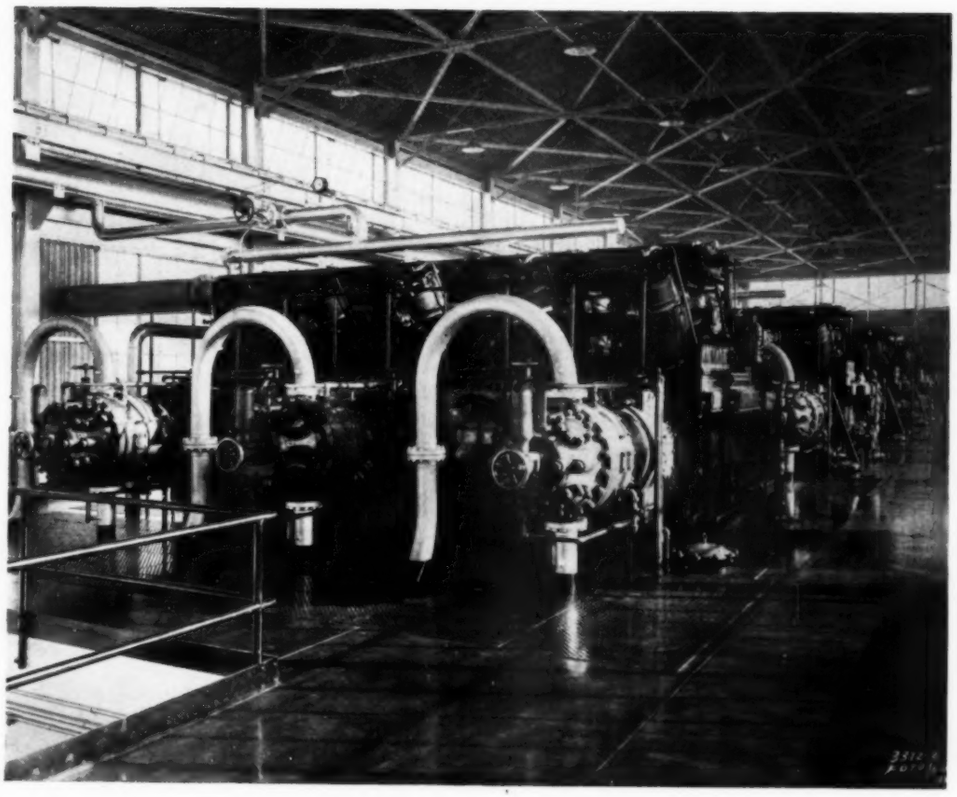

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Front Cover Illustration: The new Electro-Motive 6000 hp., 4-unit, "Wide Range" Diesel-electric locomotive seen on test run.

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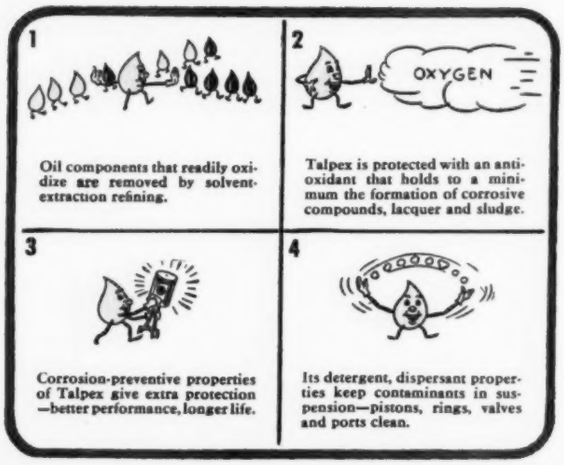
THESE FOUR *TALPEX* PERFORMANCE FACTORS SAFEGUARD HIGH-SPEED DIESELS


1
Oil components that readily oxidize are removed by solvent-extraction refining.
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Talpex is protected with an anti-oxidant that holds to a minimum the formation of corrosive compounds, lacquer and sludge.
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SHELL DIESEL LUBRICANTS

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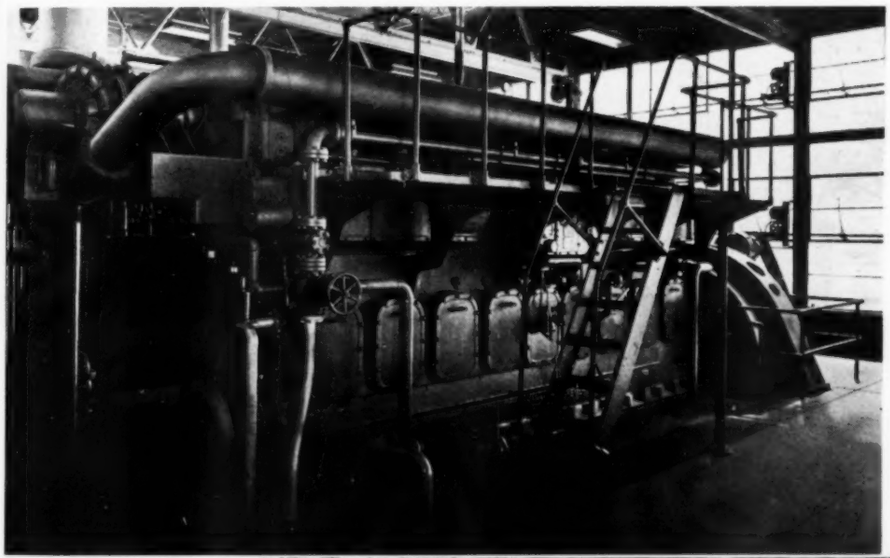
PIPELINES ORDER 110,000 H. P.

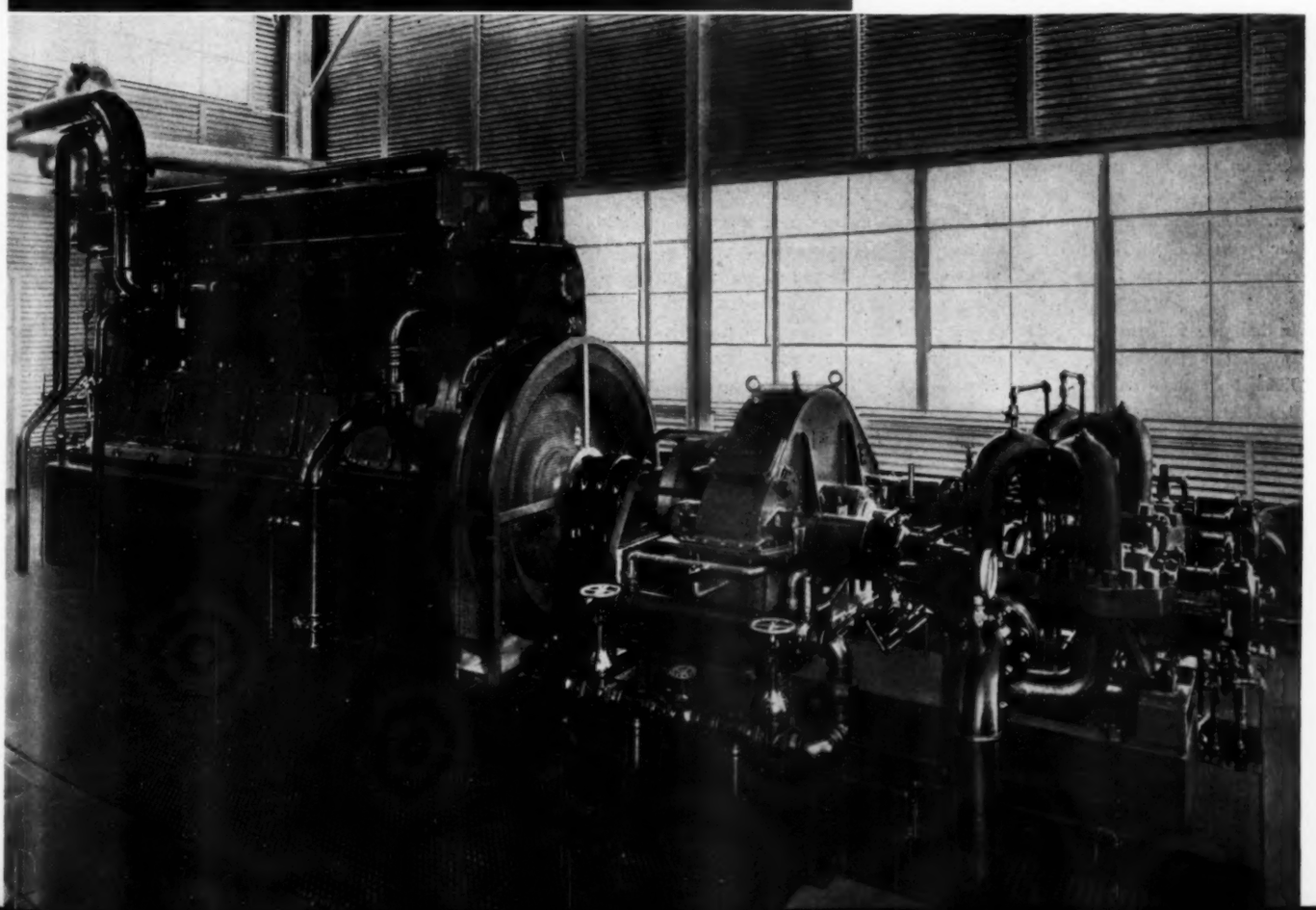
THE production of 98 engines with a total capacity of more than 110,000 horsepower for pipeline use is under way in the two plants of The Cooper-Bessemer Corporation. An order for 14 of the company's engines, with a total capacity of 18,200 horsepower, has been received from the Natural Gas Pipeline Company of America, located in Chicago. This is part of the power to be used to double the capacity of the company's pipeline extending from the Texas Panhandle region to Chicago.

Cooper-Bessemer also has had orders from the El Paso Natural Gas Company, of El Paso, Texas, for 24 GMV type engines with a total capacity of 22,800 horsepower to be used as additional power on the company's line from Texas and New Mexico gas field to the Los Angeles area. The Tennessee Gas and Transmission Company will also add ten more Cooper-Bessemer "GMV" type compressors and 15 horizontal engines to its cross-country line which furnishes natural gas to the Ohio, West Virginia area. There are already 42 of the Ohio manufacturer's compressors on this line.

The Northern Natural Gas Company is again increasing the capacity of its gas pipeline and has ordered 19 more horizontal type engines from Cooper-Bessemer. These big compressor units will add 17,400 horsepower to the line.

The Venezuelan pipeline, which is expected to be the largest capacity line ever constructed, has ordered 12 of Cooper-Bessemer's "LS" 8-cylinder engines to power two pumping stations, and four units which will drive generators in its main power plant. This line, which is now under construction by the Creole Petroleum Corp., will pump and transport oil from La Salina to the Paraguana Peninsula in Venezuela for shipment abroad.





Left, Cooper-Bessemer 8-cylinder, turbocharged Diesel driving a 1000 kw. General Electric generator. Below, 600 hp. Cooper-Bessemer Diesel engine direct-connected to Farrel-Birmingham speed increaser which drives two Byron-Jackson oil pumps. These are the type engines being ordered for pipeline installations.

WISCONSIN DIESEL PLANT

Exterior view of the Cumberland Municipal Light Plant which houses three Diesel generators.

By T. J. MALONE

IN Cumberland, Wisconsin, a city of 1600, the municipal Diesel electric plant operates on a basis said to be unique in its state and perhaps in a much larger area. The generating plant is an entity and the distribution system is an entity, each wholly separate from the other but both directed by the same authority.

The generating plant sells its output to the distribution system, its sole customer, and the latter sells the energy to the consumer. Last year, 1945—the electric plant operates on calendar years—the distribution system had 578 customers.

In that year, the generating plant, built around two 450 horsepower Buckeye engines and a 1,028 hp. Fairbanks-Morse Diesel, produced 2,408,339 kilowatt hours of energy and sold 2,309,247 to the distribution system. The average cost to produce was .978 cent a kilowatt hour. The distribution system paid 1.6 cents for every kilowatt hour delivered to it, a profit of .622 cent to generating. The distribution system received an average of 2.73 cents for every kilowatt hour it sold.

In the period of operation of the generating plant, beginning October, 1939, its production cost each year has averaged less than one cent a kilowatt hour. Its sale price to distribution has been constant at 1.6 cents, while revenue to distribution has ranged, by years, from a high of 2.96 cents to a low of 2.73.

Cumberland is proud of its unusually low rates to consumers. They will be gone into presently.

The dual-plant system is an outgrowth of a municipal steam electric plant which the city operated from about 1904 to 1918, when it turned to purchase of utility transmission service. It continued to operate the distribution system. On expiration of the utility's 20-year contract, the city went back to generating its own energy, this time by Diesel engine.

Delaying tactics by the utility, which sought a new contract, led to court action in favor of the city. It built a power house and installed two Diesels, each of six-cylinders and 300 kilowatts rated capacity. As part of the improvement program, the distribution system was virtually rebuilt. Increase in the demand for energy led to addition of a third Diesel, the Fairbanks-Morse, of six cylinders and 713 kw. capacity. It began operating January 31, 1945. In the electric power plant, the generating equipment—engines, alternators and auxiliaries—has a total horsepower of 1,928 and a rated capacity of 1,313 kilowatts. The peak load in the first seven months of 1946 was 720 kw.

Performance of the generating equipment and unit kwh. costs and revenue are indicated in Table A.

The kilowatt price of 1.6 cents to the distribution system is a constant. At the outset, the city signed a waiver to the Wisconsin State Power Commission to stick to that figure in consideration of getting a permit to go ahead with addition of a generating plant. The utility had been charging the city 1.45 cents a kilowatt hour, but asked 1.65 cents in its overture for renewal of contract.; The Cumberland folk advocating a generating plant had pledged to the community that such a plant would always operate at a profit. The plant is run as a separate entity to prove to all concerned that it is making a profit.

Fuel economy of 11.18 kilowatt hours to the gallon in 1940 reflected the efficiency of engine

PROUD OF LOW RATES

operation through running the two engines alternately for long periods. The economy of 11.70 of 1945 was accounted for by the fact that the new Diesel, the 1,028 hp. F-M, was run alone a great number of hours, 3,887 in eleven months, while each of the other engines ran a shorter time, 2,981 hours for one and 2,409 for the other.

Industries are the largest users of power in Cumberland, 669,667 kwh. in 1945, on 28 meters. A vegetable canning factory used 312,300 kwh. Other major industries include a cheese factory, a factory making wooden window shades, a locker plant, a rutabaga wholesale warehouse where that toothsome vegetable is both washed and waxed for the retail trade.

Number of meters served with current in 1945 and distribution volumes were as follows:

		Kwh.
Residential	400	391,331
Commercial	128	575,478
Power	27	357,367
Primary demand power	1	312,300
Water heating	15	48,040
REA	1	135,480
Public street lighting	1	166,998
Sewage lift and disposal pt.	5	32,369
Water pumping and donations	0	124,803
	578	2,144,166

The REA entry is out of the ordinary. The plant has no REA contract but, having plenty of reserve with addition of its third Diesel, it helped out, in a pinch, a cooperative that normally gets its energy from the municipal Diesel plant in Barron, Wisconsin, about twenty miles away.

Cumberland likes to tell the world about its rates to consumers. It is still using the schedules that had been in use by the distribution system before the generating plant appeared on the scene. They are, monthly:

Residential—30 kwh. at 4½ gross, 4c net; 170 kwh. at 3½c gross, 3c net; balance at 2½c net; fixed charge, 55c gross, 50c net; minimum charge 55c gross, 50c net.

Commercial—100 kwh. at 4½c gross, 4c net; 400 kwh. at 3½c gross, 3c net; balance at 2½c net; fixed charge, 55c gross, 50c net; minimum charge, 55c gross, 50c net.

Power—20 kwh. per hp. connected, 5c; 523 kwh. at 3c; balance 2c; minimum 3 hp. $3.00 gross, $2.70 net; each additional hp. 65c gross, 60c net.

Net amount is due on the eighth of the month, gross by the twelfth. An average residential bill, 90 kwh., carries a charge of $3.40 net, $3.90 gross.

What has been the investment in the electric plant, how much has been paid on it, what remains to be paid? As of December 31, 1945, the valuation, without depreciation, of land, building, equipment and distribution system stood at $242,893. Two federal grants (PWA) received in aid of construction totalled $63,386. A total of $37,098 had been paid on the investment from earnings on open account. Payment from earnings of $27,000 on a total of $120,000 revenue bonds left $93,000 still outstanding. Paid-in capital, embracing distribution system mainly, accounted for the rest.

Besides payments on the investment, the plant has made permanent transfers from earnings of $4,000 yearly to the city's general fund and of $13,200 to the water department toward completion of a well and pumphouse. And still there was a plant surplus of $20,472 at the end of 1945.

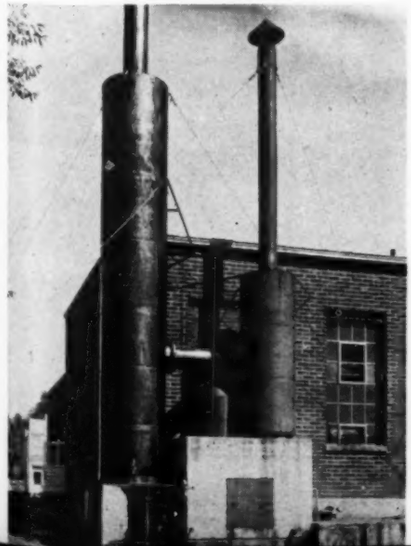
A commission of five members directs both generation and distribution plants, and the municipal water department as well, all forming the Cumberland Municipal Utility. J. M. Nelson is president. His associates are J. F. Benjamin, W. G. Talbot, H. R. Hines and H. S. Rose. Messrs. Nelson, Talbot and Hines have been commissioners since the generating plant was installed. C. D. Maxey is superintendent.

Table A

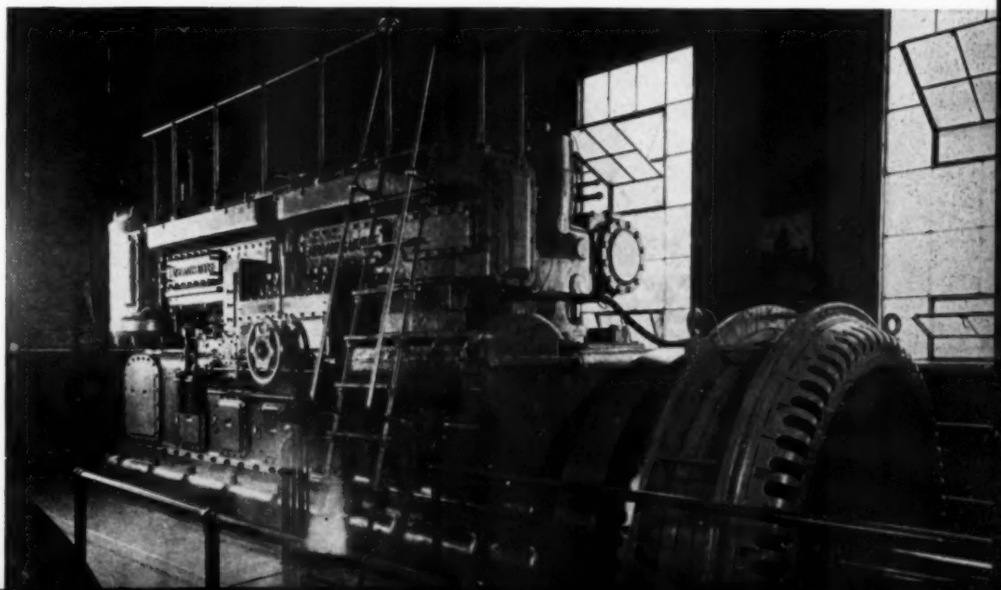
Year	KWH generated, gross volume	Average gen. cost per KWH sold to distrib. system	Average KWH price paid by dist. system	Average KWH rev. rec'd. from consumer	KWH per gal. fuel oil	Peak load kw	Rated capy. kw
1939	65,545*						
1940	1,255,700	.980 cent	1.6 cents	2.92 cents	11.18	430	600
1941	1,525,857	.931	1.6	2.93	10.55	560	600
1942	1,600,800	.9775	1.6	2.96	10.66	520	600
1943	2,008,300	.965	1.6	2.73	10.95	580	600
1944	2,012,700	.965	1.6	2.87	11.10	550	600
1945	2,408,339	.978	1.6	2.73	11.70	700	1313
1946	1,484,100 (7 months)		1.6	. . .	11.55	720	1313

*(October-December; Private utility supplied 1,013,126 KWH.)

Rear view of the plant shows Maxim air intake and exhaust silencer installation specially designed for the Fairbanks-Morse Diesel.



This 1,028 hp., 257 rpm. Fairbanks-Morse Diesel helped the plant set a new fuel economy mark of 11.70 kwh. per gallon of fuel in 1945.



AUTOMOTIVE HYDRAULIC DRIVE

By BRUCE C. SISSON

FROM the Acrotorque Company of Stamford, Conn., comes word of a new hydraulic transmission. The company which has developed this was formed several years before the late war and was well on the way towards the completion of the drive when the war intervened. Now, the company engineers, Eli Orshansky and Tilden Southack are ready with a new, highly flexible, high speed hydraulic drive for rail, truck, tractor, bus and marine applications which shows good efficiency characteristics over its entire speed range. The drive seems destined to be used in conjunction with Diesels for the reason that it is designed to deliver power within a wide range of speeds and torques from a prime mover operating at optimum speed and output.

We had the privilege of seeing a test run made on the new transmission and found out what made it tick. The secret of the entire operation lies in the hydraulic pump and motor combination. Both pump and motor are of the radial-cylinder type with adjustable stroke pistons. Th prime mover drives the pump directly and the pump in turn develops the hydraulic power for the motor. The control system is ingenious. It utilizes an auxiliary hydraulic system controlled by a follow-up type valve and piston mechanism which regulates the piston stroke of both the pump and the motor. The actual mechanical control is accomplished by a unique sliding key, recessed in the respective drive shafts of the pump and motor which control the eccentricity of the drive rings and thus the stroke of the pistons. There is one power stroke for each piston per revolution.

Acrotorque engineers pointed out the safety features in the design which include a pressure relief valve and a cooling system for the hydraulic fluid used in the unit. The test curves indicate a maximum efficiency of 80% with a flatter curve at 125 and 150 hp. ratings. The torque characteristics are such that the torque output is directly proportional to the pressure. Thus the greatest torque available is at the start. Units developed to date operate on pressures up to 3000 psi.

Acrotorque has developed an adaptation of its full hydraulic drive in the form of a gear-hydraulic drive which gives the high efficiency of gearing as well as the flexibility of hydraulic operation. It is designed specifically for use where most of the operation occurs at some one speed with other speeds being used less frequently. It is ideally suited for use in heavy trucks and busses and military vehicles such as gun carriers and tanks. The gear-hydraulic transmission consists essentially of a planetary gear, a pump and a motor as shown in Figure 3. The effect of such an arrangement is that at normal running speeds with the pump at maximum stroke, and the motor at zero stroke, no oil can flow out of the pump in spite of the rotation of the motor. The pump is then locked against rotation, and acts as a brake on gear (7) and consequently on ring gear (6), preventing these from rotating. Under these circumstances all the power is transmitted mechanically, from shaft (1) and gear (2) to idlers (3) and cage (4) and output shaft (5). The pump stands still and the motor shaft is turning without moving the pistons. No power is transmitted hydraulically and all is transmitted mechanically to the driven parts.

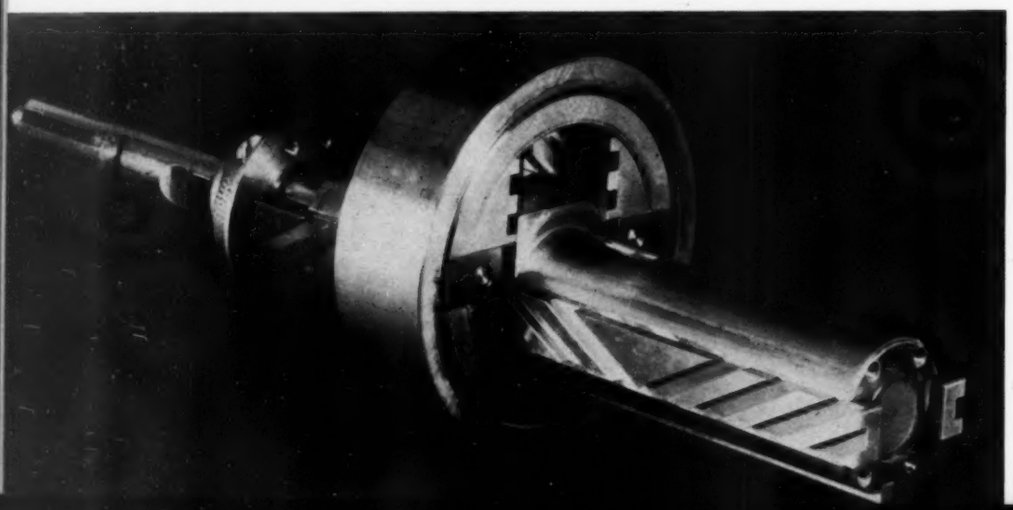
If the motor stroke is increased from zero, it can now rotate, and allows gear (6) to rotate begins to receive oil from the pump, the pump also. This slows down output shaft (5), due to planetary action, but at the same time the torque on shaft five is increased due to torque added by he hydraulic motor. The greater the motor stroke, the slower shaft (5) turns, but more torque is added by motor (11). It is seen therefore, that this is a full power, variable torque transmission, combining the efficiency of the gearing with the flexibility of the hydraulic drive installation.

The effect of the introduction of gearing to the hydraulic drive is easily seen in the comparison of Figures 1 and 2. Figure 1 gives the maximum efficiency of the full hydraulic drive as 80%. The gear hydraulic transmission shows an efficiency of over 80% for 2/3 of the operating range. The torque characteristics of the two drives are very similar.

A typical Acrotorque pump is designed for industrial as well as automotive use. For industrial use it is rated at 110 hp. at a speed of 1750 rpm. Its displacement rating is 124 gpm. at a pressure of 1500 psi. For automotive use it is nominally rated at 200 hp. at a speed of 2400 rpm. The weight of this 7 cylinder unit is 320 lbs. Its dimensions are 25 x 18 x 21 inches. In the majority of instances the hydraulic motor is identical with the pump but in some applications sufficient speed control may be obtained by using a variable stroke pump and a fixed stroke motor. Each compact unit has a weight per horsepower of 1.6 lbs.

Another comparison of the full and gear-hydraulic drives reveals that while the full hydraulic transmission is reversible, the gear-hydraulic requires the addition of reverse gear-

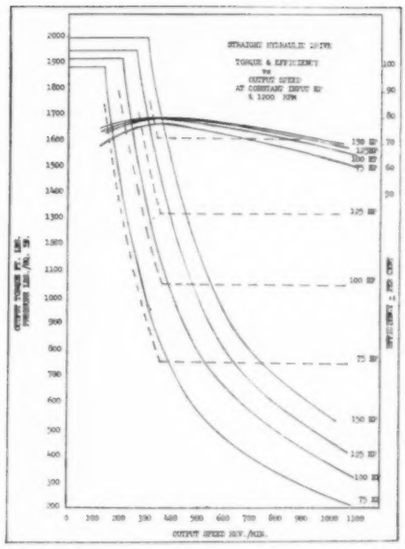
Pump drive-shaft assembly showing drive ring in place. Eccentricity of the drive ring is determined by the movement of slotted keyway bar.



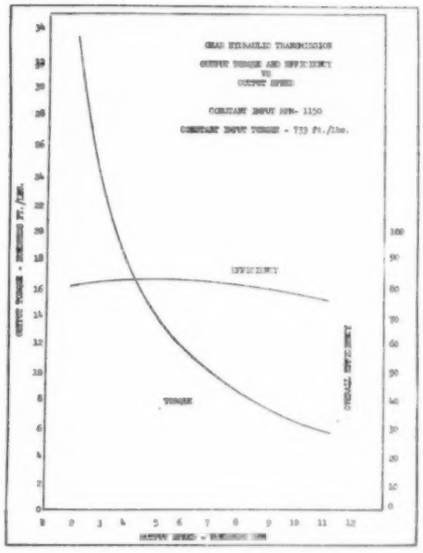
Valve assembly of the Acrotorque pump. Upper left is valve sleeve.

ing. **Furthermore**, this type requires that the driven member cannot be remote from the driving member. This limitation is not imposed for the full hydraulic transmissions as they can be separated pump from motor by an appreciable distance without affecting efficiency. However, the limitations of the gear-hydraulic transmission are offset by its efficiency in automotive applications.

The future of hydraulic drive seems bright especially in the Diesel transportation field. Its lack of complicated electrical equipment, the simplicity of operation, and its flexibility are important factors to consider. Most important of all is the fact that it is possible with hydraulic drive to operate the Diesel at its most efficient speeds and still be able to deliver high torque smoothly at low speeds.

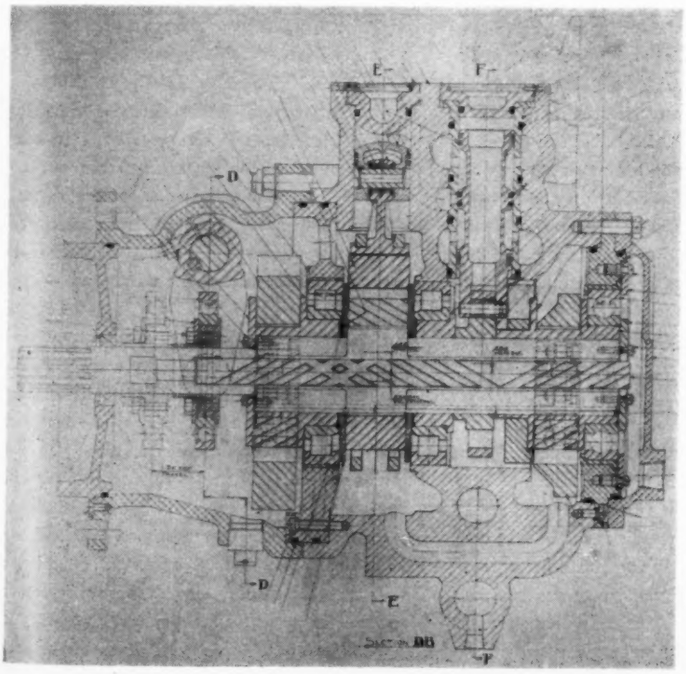


(Figure 1.) Curve of Efficiency and Torque vs. Output Speed for the Acrotorque straight hydraulic drive at a constant input hp. and rpm.

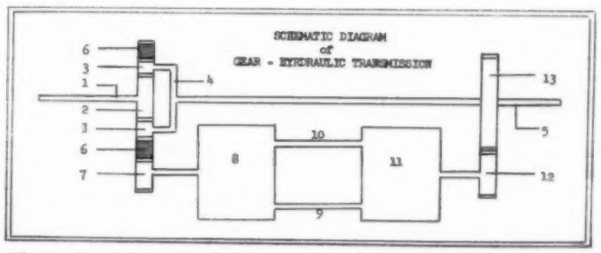


(Figure 2.) Output Torque and Efficiency vs. Output Speed for the Acrotorque gear-hydraulic drive at a constant input hp. and rpm.

Working drawing showing relation of valve and piston in the Acrotorque pump.



Piston and drive ring assembly. Note the two piston rings on each piston.

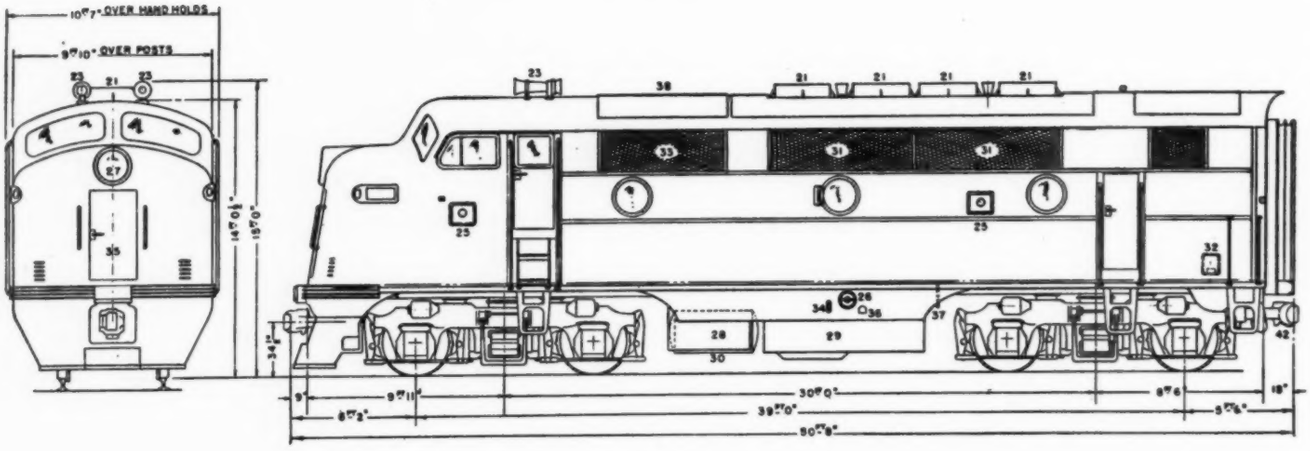


(Figure 3.) Schematic drawing of gear-hydraulic transmission. (1) Input shaft. (2) Sun gear. (3) Planet gear. (4) Gear cage. (5) Output shaft. (6) Ring gear equipped with internal and external teeth. (7) Pump drive gear. (8) Variable stroke hydraulic pump. (9) Low pressure piping. (10) High pressure piping. (11) Variable stroke hydraulic motor. (12) Motor gear. (13) Gear integral with drive shaft.

View of assembled Acrotorque pump. Motor is identical to pump.

"F-3", ELECTRO-MOTIVE'S NEW WIDE-RANGE DIESEL ELECTRIC LOCOMOTIVE

By WILBUR W. YOUNG



AT the apex of a massive pyramid of experience, broadly and firmly based on some 200 million miles of high speed passenger service and over 160 billion ton miles of freight hauling for units of Electro-Motive manufacture, stands the new F-3, wide-range Diesel-Electric Locomotive. Latest of Electro-Motive's pioneering achievements, the F-3 is aimed at giving the railroads a standardized, production-type motive power unit which will, with comparatively simple adaptations, satisfy a wide variety of road operating conditions.

Twenty-one Class 1 railroads ran up 110,000 miles on this new locomotive under all operating conditions in both freight and passenger services prior to the widely-heralded announcement last October. These tests were conducted over a period of 14 months and now Electro-Motive is launched on a mass production program against a back-log of orders totaling 1,177,500 horsepower. The first lot, geared for 100-mile-an-hour passenger service, goes to Santa Fe to haul the Super Chief and Chief.

What has Electro-Motive done to achieve this all-purpose, wide-range Diesel-electric locomotive? In the first place, our railroads have been hampered for years by the multiplicity of steam locomotive models required for the wide range of operating conditions encountered within each system. The railroads have needed motive power with a performance range sufficient to serve as either a heavy duty fast passenger or heavy duty freight locomotive, or as a combination of both. Working on this problem, Electro-Motive found that its widely-used 1,350 hp. freight unit incorporated many of the required characteristics, in fact one Class 1 railroad had already converted ten of its 5,400 hp., four-unit General Motors freight locomotives to 100-mile-an-hour passenger locomotives.

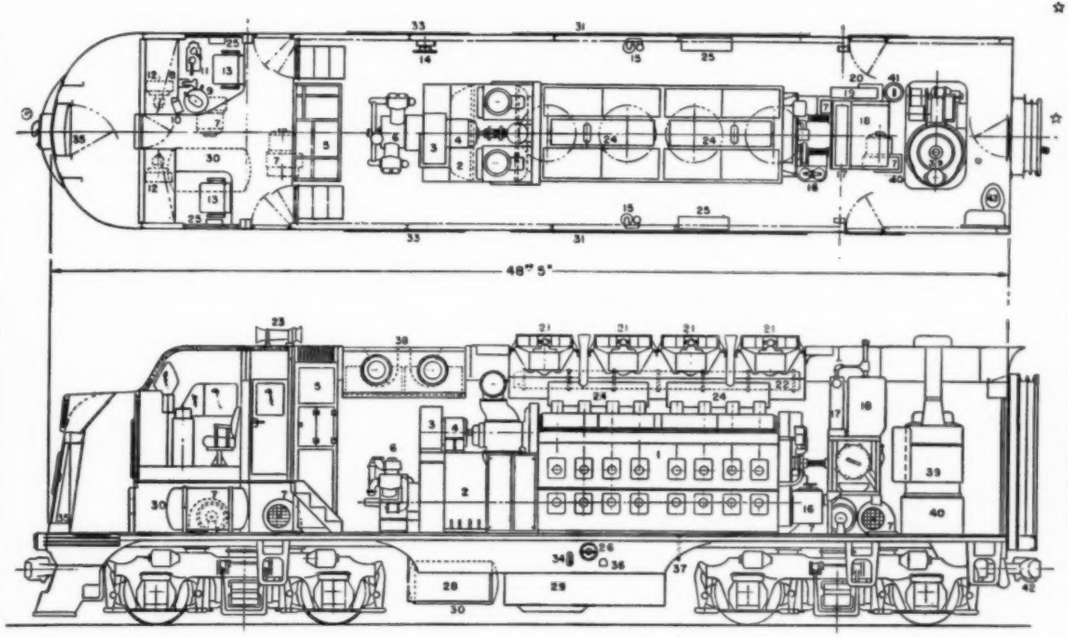
So, using the freight locomotive as a basic unit, by changing to one of seven standard gear ratios the F-3 was evolved as a basic unit of 1,500 hp. rating which can be readily equipped to perform as a heavy dragging freight locomotive or a high-speed, heavy duty passenger locomotive. One of the gear ratios renders the unit available for combination passenger and freight service. These units may be used singly or coupled in combinations of 2, 3 or 4, with corresponding ratings of 1,500, or 3,000, or 4,500, or 6,000 hp. Thus it is seen that the product of the four combinations of units times the seven gear ratios gives twenty-eight locomotives of essentially different characteristics, all derived from one basic unit. Gear changes are readily made in the railroad's own shops in a few hours.

The prime mover, one in each locomotive unit, is the General Motors series 567, 16-cylinder, two cycle Diesel, of which Electro-Motive has installed nearly 3 million horsepower in locomotives and over 2 million horsepower in Navy vessels. The electrical transmission is redesigned to permit delivery of 1,500 hp. from the engine for locomotive propulsion, with an additional 165 hp. available to operate auxiliaries.

Electro-Motive has designed a new-type generator which produces both alternating and direct current—1,500 hp. in direct current for train propulsion and at the same time sufficient alternating current to operate accessories and auxiliaries. All of the pumps, fans, blowers, heating equipment, etc., are driven by individual alternating current motors. This permits convenient grouping of accessory equipment both from the standpoint of space conservation and ease of servicing. It also eliminates engine extension shafts, V-belts and other mechanical transmissions.

Maintenance in the F-3 is simplified by grouping of equipment for individual services in sub-assemblies. For example, all of the liquid supply equipment, such as, cooling water, fuel and lube oil pumps, tanks, etc., have been grouped in a rack which is mounted so that it is accessible from all sides. The electric brake grids and equipment are located in a single assembly in the roof under an easily removable hatch. All of these sub-assemblies can be re-

1500 H.P. MODEL F3 LOCOMOTIVE "LEAD" UNIT

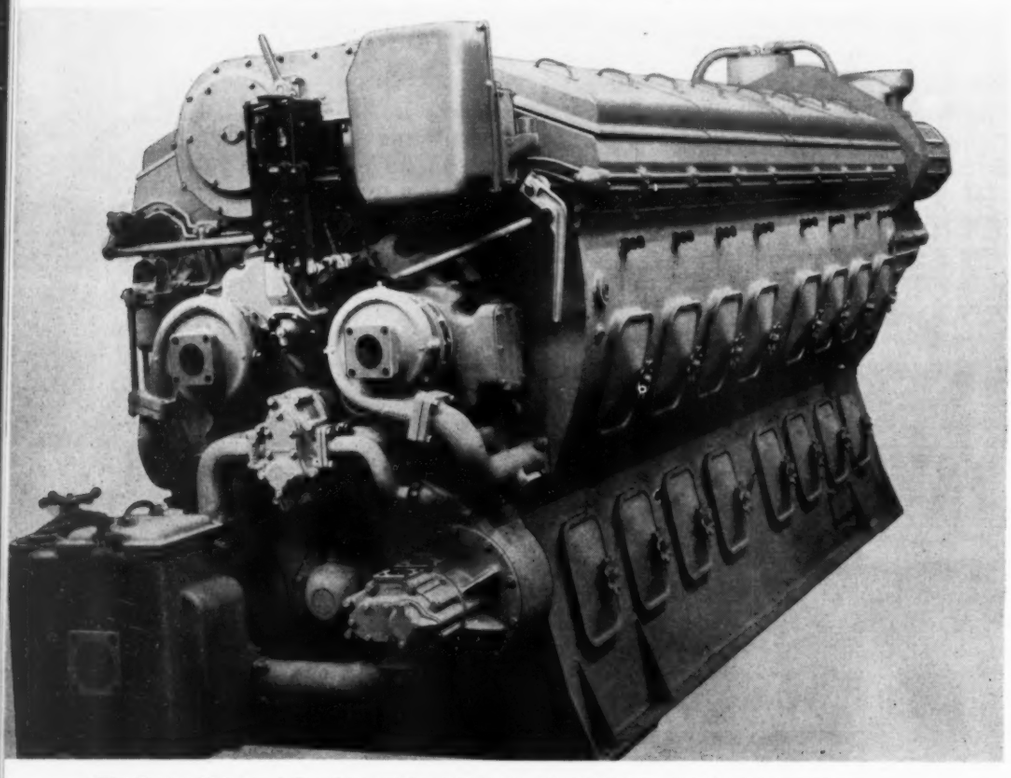


⊕ 42 COUPLER BETWEEN UNITS
☆ 41 BOILER WATER SOFTENER
☆ 40 BOILER WATER TANK, 200 GAL.
☆ 39 BOILER
☆ 38 DYNAMIC BRAKE GRIDS & BLOWERS
37 ENGINE WATER FILLER
36 EMERGENCY FUEL CUT-OFF
35 DOOR, (PLAIN)
34 FUEL TANK GAUGE
33 AIR INTAKE FOR GRIDS & ENGINE ROOM
☆ 32 BOILER WATER FILLER
31 AIR INTAKE & SHUTTERS
30 MAIN AIR RESERVOIR
29 FUEL TANK, 1200 GAL.
28 BATTERIES
27 HEAD LIGHT, (FIXED BEAM)
26 FUEL FILLER
25 SAND BOX
24 EXHAUST MANIFOLD
23 HORN
22 RADIATOR
21 36" FAN & MOTOR
20 LOAD REGULATOR
19 ENGINE CONTROL & INSTRUMENT PANEL
18 ENGINE WATER TANK
17 LUB. OIL COOLER
16 LUB. OIL FILLER
15 FUEL TANK VENT WITH FLAME ARRESTOR
14 HAND BRAKE
13 SEAT
12 CAB HEATER
11 AIR BRAKE VALVE
10 SPEEDOMETER RECORDER
9 CONTROL STAND
8 INSTRUMENT BOARD
7 TRACTION MOTOR BLOWER
6 AIR COMPRESSOR
5 CONTROL CABINET
4 AUX. GENERATOR
3 GENERATOR BLOWER
2 MAIN GENERATOR & ALTERNATOR
1 ENGINE E.M.D. MODEL 16-567 B

☆ MODIFICATIONS
⊕ OPTIONS

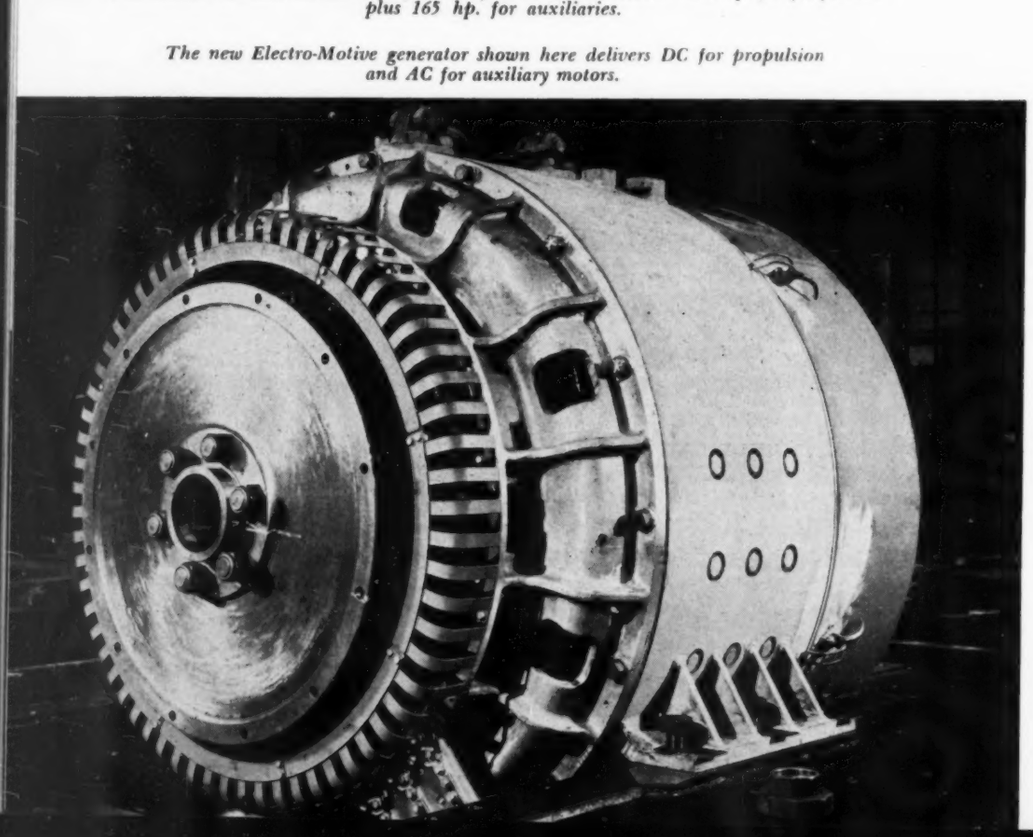
The Electro-Motive F-3, 6000 hp., 4-unit wide-range Diesel-electric locomotive.

Airplane view of the Electro-Motive plant at La Grange, Illinois.



The General Motors 567 series, 2-cycle, 16-cylinder Diesel delivers 1500 hp. for propulsion plus 165 hp. for auxiliaries.

The new Electro-Motive generator shown here delivers DC for propulsion and AC for auxiliary motors.



moved quickly and may either be replaced or repaired on the bench. Such refinements are calculated to increase the overall percentage of availability of the locomotive.

In bringing the F-3 locomotive to its present state of versatility, Electro-Motive has adhered to the principle of short length units which have been proved highly successful in its former freight locomotives. The load or "A" unit measures only 50 ft. 8 in. over the coupler faces and the "B" unit measures just 50 ft. The distance between bolster centers is increased to 30 ft., however, to create optimum relationship between overhang and the distance between wheel centers. The trucks are of the four-wheel type, capable of taking any maximum degree curves that an ordinary freight car will take. The Electro-Motive outside swing hanger plus fine balance between eliptical and helical springs provides excellent stability in high speed operation.

Some twenty-five class 1 railroads are now using General Motors to haul better than 110 of their crack passenger name trains. A partial list of these trains reads like a travel agent's who's who. For example, the Alton's "Abraham Lincoln" and "Ann Rutledge"; the Santa Fe "Super Chief" and "Chief," also "El Capitan" and "Chicagoan"; the Atlantic Coast Line "Havana Special," "Florida Special" and the "Palmetto"; Boston and Maine's "Pine Tree," "Minute Man," "State of Maine" and "Flying Yankee."

B & O's "National Limited," "Diplomat," "Royal Blue," and "Marylander"; Chicago and North Western's "400's"; C. & E. I. "Whippoorwill" and "Meadowlark"; C. B. & Q. "Zephyrs"; C, M, St. P & P "Hiawathas"; Chicago, Rock Island & Pacific "Rockets"; Florida East Coast "Champion," "Gulf Steam"; Great Northern's "Empire Builder" and "The Gopher"; Illinois Central "Panama Limited," "Green Diamond," "The Night Diamond" and "Land O'Corn"; Kansas City Southern "Southern Belle"; Louisville & Nashville "Pan American" and "Azalean"; Missouri Pacific "Eagles"; New York Central "20th Century Limited," "Knickerbocker" and "Southwestern Limited"; Pennsy's "Red Arrow"; Seaboard "Silver Meteor," "Sun Queen" and "Robert E. Lee"; Southern Ry. "Tennessean," "The Crescent," and "Piedmont Limited"; Union Pacific "City of Portland. Denver and Los Angeles"; Union Pacific-Chicago & North Western-Southern Pacific "City of San Francisco"; and Union-Pacific-Wabash "City of St. Louis." These and many other lines will be vitally interested in the new F-3 wide-range Diesel-electric locomotive.

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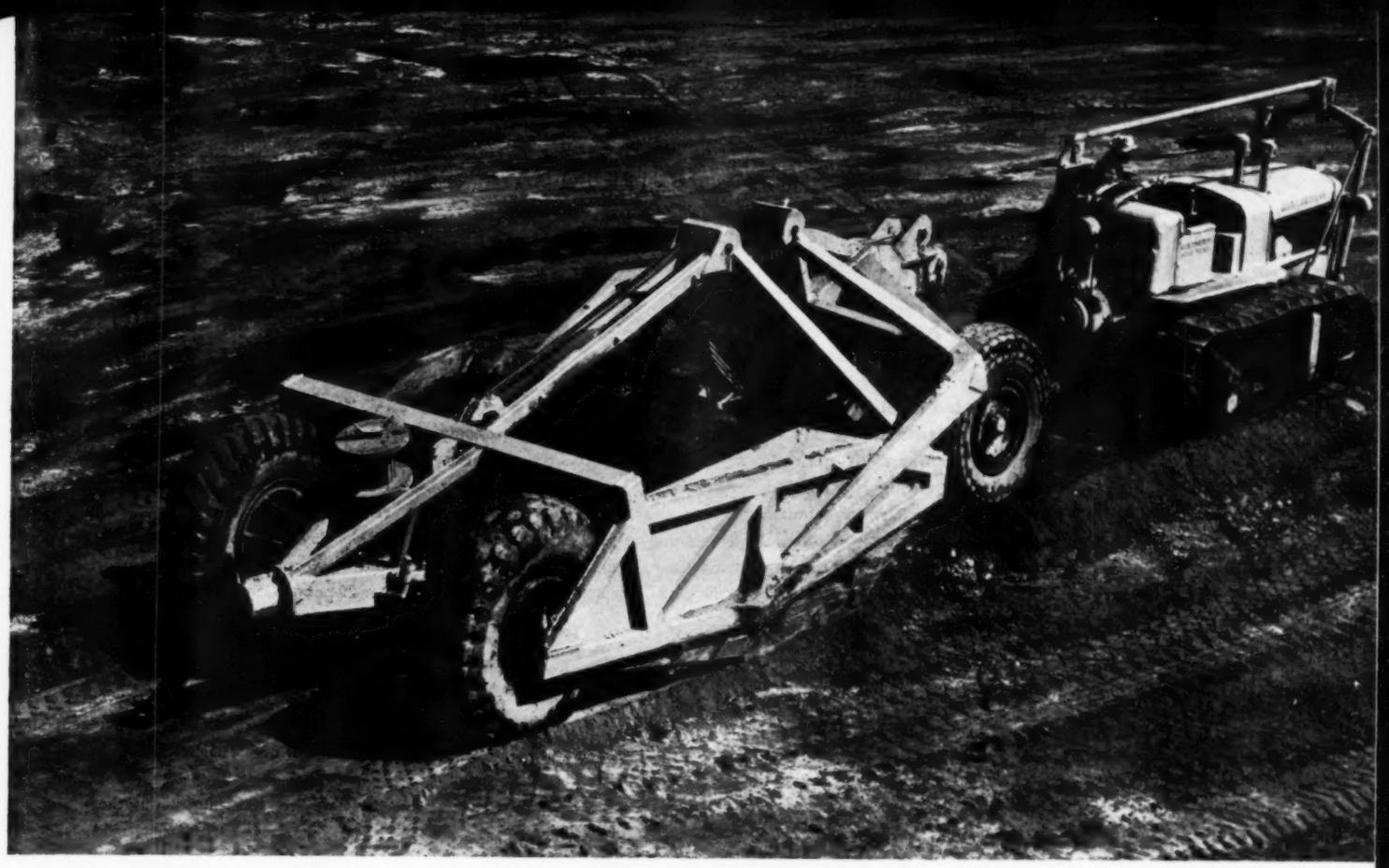


Walter Shaull operates this Allis-Chalmers tractor and Gar Wood cable scraper to remove the overburden from rich coal vein in Ohio.

DIESEL ROAD EQUIPMENT MINES COAL

By DWIGHT ROBISON

COAL stripping with road construction machinery became a lively pursuit during World War II, and although highway construction is now commanding more than its usual attention, an unprecedented demand for coal finds many construction men still deploying their road equipment in open-pit mines.

Walter Shaull, a former Pennsylvania road contractor who has experienced unusual success in coal stripping, recently started another operation at the Bradley Mine, five miles northwest of Barnesville, Ohio. He has been on this site for only three months but already has uncovered one hundred thousand tons of Pitt. No. 8 vein bituminous coal.

Equipped with two Allis-Chalmers crawler tractors, a Buckeye bulldozer, a 15 yard Gar Wood cable scraper, and a 2 yard Manitowoc "3000" shovel, Shaull's crew expect to mine 2½ million tons of coal now laying beneath less than 25 feet of overburden. Shaull's system is to push off the top soil with the bulldozer and scraper, letting the shovel handle the last six to eight feet of shale and rock. After this the scraper is used to clean off the top of the vein.

Although he has not contracted to cart the coal from the mine, Shaull uses an Allis-Chalmers motor grader to maintain about three miles of haul road, one mile of which is cut through the pit. In this manner Shaull feels that he is helping himself by keeping the Tomer trucks rolling. While this would seem to be their mutual concern, the fact that Shaull has more productive and expensive equipment tied up in the operation makes him ever anxious to keep the trucks going. Another practical application of the Diesel on this job is achieved by means of a scarifier attachment which enables the grader to rip up the bony (a composite layer of earth and coal—3 to 14 inches thick—laying over the coal vein—it is not combustible). This operation expedites cleaning of the vein after the overburden has been removed.

Today there are almost 1250 strip mines operating in the United States, producing approximately 19% of the nation's total coal supply.

How long this industry will continue to prosper is anybody's guess, but the development of mechanical equipment capable of moving larger quantities of overburden will be a deciding factor. Also to be considered is the utility of the equipment involved. Inactivity in highway construction during the war found road machinery doing a wonderful job in strip mines, proving beyond a doubt that such equipment can pay for itself in more ways than one. It is generally accepted that this type of equipment accounted for the most spectacular production increase of coal output in American history which helped the industry maintain the record capacity necessary to win the war. Strip mining has become a large industry that forms an important part in the economy of our nation. Road equipment helped bring this about, so it is only logical to assume that this type of machinery has become an important tool in the business.

THE SAN FRANCISCO MARINE CONFERENCE

By REX W. WADMAN

SAN FRANCISCO, November 7: Top ranking officials of the Diesel industry met with a large and representative group of West Coast shipbuilders, ship owners, operators, and naval architects here today in a Marine Conference, sponsored by D.E.M.A., that went far toward defining their mutual interests besides setting the pattern for future meetings of a similar nature to be scheduled in other parts of the country. The intensely interested group were told, with supporting facts and figures, just why Diesels are superior to other types of marine propulsion machinery. That, in truth, was the purpose of the meeting—to give the West Coast marine brotherhood a plain, unvarnished and factual sales talk on marine Diesels.

E. J. Schwanhausser, President of the Diesel Engine Manufacturers Association and Vice President of Worthington Pump and Machinery Corporation, presided and opened the meeting with a frank statement of its purpose. Mr. Schwanhausser said in part: "We are holding this conference so that we from the Diesel engine industry can sit down with you men from the merchant marine industry, answer your questions and talk frankly about what we have that fits into your picture. . . . We have something to offer the merchant marine industry that we did not have to offer before the war."

E. J. Schwanhausser

Pointing out that under the urgency of war production the industry's engineering talent worked overtime to develop the best engines of which they were capable, Mr. Schwanhausser highlighted such improvements as, "Lighter weight and more compact engine units, improved supercharging and combustion systems, advances in metallurgy, precision manufacture and improved fuel injection systems."

A series of talks ensued, the first being given by G. F. Twist, Executive Vice President of Atlas Imperial Diesel Engine Company, on the question, "Why have practically all fishing fleets, tugboats, towboats and ferries on the West Coast adopted Diesel engines for propulsion." Following an historical review of the development of Diesel marine application, Mr. Twist said:

"From the first, the Diesel's operating economy proved conclusively that it was the most economical prime mover for all types of power requirements. Because of this and its reliability, the Diesel engine has earned and continues to maintain its place as a dominant factor in Pacific Coast commerce and industry."

There followed a talk by H. G. Vesper, President of California Research Corporation, a company owned by Standard Oil Co. of California, in which he ably answered a number of questions relating to fuels and lubricants. Because Mr. Vesper's talk extended considerably beyond the marine field itself and contained so much of general interest, it will be reported separately in a later issue.

Launching into the heart of the agenda, R. H. Morse, Jr., Vice President of Fairbanks, Morse & Co., assayed two vitally important questions, "What are the advantages of Diesel over steam for coastal vessels?" and "Since many coastal ships are in port three-fifths of the time, is the extra cost of a Diesel installation in these ships justified?" Because these questions are so closely interrelated Mr. Morse did a masterful job of answering them with one mass of convincing evidence. Drawing heavily on European marine Diesel experience, by contrast, Mr. Morse clearly showed how we in this country have failed to realize the possibilities of Diesel ship propulsion. Consider some of his pointed statements on this subject: . . .

R. H. Morse Jr.

. . . "During the decade before the war (1930 to 1939), about 80 per cent of the coastal vessels built on the Continent and 50 per cent of those built in the United Kingdom were equipped with Diesel engines. . . .

. . . "Since the conclusion of the war, orders placed for coastal ships are mainly for Diesel vessels, certainly not less than 90 per cent on the Continent and 80 per cent in Britain. . . .

. . . "These facts indicate that British and Continental owners are now relying almost wholly on Diesel machinery for coastal vessels. The Coaster, fitted with 1000 shaft horsepower machinery, will consume about 4.3 tons of Diesel oil per day of 24 hours if running at full power, and the cost at present prices in Britain would be 22-pounds-ten per day. A corresponding coal fired ship would consume 17 tons of coal at three pounds per ton, a daily cost of 51 pounds. A steamer with oil fired boilers would require about 8.5 tons of oil, costing at current prices about 37 pounds—or 70 per cent above the fuel cost of the Diesel vessel.

"Lest we feel too smug about the position of the United States in today's world wide shipbuilding program, let's consider a few figures relative to tonnage on order and under construction as of September first of this year.

"We are building 20,000 tons of motor ships. The other countries of the world are building 4,165,000 tons of motor ships. We are building 380,000 tons of steam ships. Our competitors for world commerce are building 1,876,000 tons of steam ships. Our building program is 5 per cent Diesel and 95 per cent steam. The balance of the world program is 68 per cent Diesel and 32 per cent steam. This is not living up to the technological supremacy on which we built the strength of our nation. The Diesel is the new and coming thing, and here we have been left badly behind in one of its most obvious and useful applications.

"We bemoan the competition of foreign ship- in world trade. Whatever may be other contributing factors, our competition believes in the Diesel as an instrument to capture and hold its commerce on the sea. This is something for us to think about. . . .

. . . "The question is raised regarding the increased cost of the Diesel vessel as compared with the steam ship. In Europe there seems to be little difference in costs. We believe that the difference if any in this country is because the average builder has had more experience in building steam powered vessels, and quotes as a result a higher price because of his lack of

experience in installing Diesel machinery. This is a condition to be corrected by cooperation between Diesel manufacturers, naval architects, marine engineers and shipbuilders."

J. H. G. McConechy, Chief Engineer of Sun Shipbuilding & Dry Dock Company, plunged still deeper into the question of comparative costs as between Diesel and steam ship propulsion and came up with some startlingly simple but well authenticated facts. Proof after proof of Diesel supremacy were submitted by Mr. McConechy—of which the following examples are typical: . . .

. . . "The main advantage of a Diesel Engine Propelling Plant in a tanker or cargo vessel is the low cost of operation which includes a comparatively low fuel rate, low maintenance cost and the ability of the vessel to carry more pay-load in place of fuel. On a series of six vessels, each equipped with a four cylinder engine with independent motor driven scavenger blowers and developing 6000 shp. at 92 rpm. and 6600 shp. maximum continuous rating at 95 rpm. an average overall fuel rate of .384 lb. per shp. at normal rating was obtained. At 10% overload or 6600 shp. the overall fuel rate was .402 lb. per shp. hour. These rates are all referred to 19,500 Btu. per lb. oil. The fuel rate at normal power .384 lb./shp. as compared to about .60 lb./shp. in the average modern steam propelled cargo vessel, permits a material gain in pay-load carrying capacity where definite voyage routes are established. . . .

"The following is a comparison of the Engine Room initial costs for equipment of various types of drives for a given shp. output as installed in tankers. The cost of pumping equipment and deck machinery is assumed to be constant in all cases:

Direct Diesel Drive	$1,000,000.00
Geared Diesel Drive Two Engines with Electric Couplings and Reduction Gears	1,195,000.00
Cross Compound Turbine With Double Reduction Gears and High Pressure Boilers	1,000,000.00
Turbo Electric	1,090,000.00

"The overall fuel rate includes Diesel driven generators which furnish power for the total auxiliary load, the steam driven boiler feed pump, fuel oil heating and quarters heating load. The steam load demand during normal operation is generated with the Diesel Engine Gas Exhaust Boiler. The average electric load in the above overall fuel rates was 550 kw."

R. W. Bayerlein, Manager Heavy Machinery Division, Nordberg Manufacturing Co., here took up the question, "Why Diesel engines in our merchant ships?" Pointing out that the modern Diesel engine is a highly perfected machine in which simplicity and standardization of parts have minimized repair costs, Mr. Bayerlein drew heavily from the performance of Nordberg Diesel propelled vessels to show the impressive operating cost advantage of Diesel ships. Note this example:

R. W. Bayerlein

. . . "The thousands of miles covered by some of the routes of special interest to the West Coast and where Diesel propulsion is advantageous, can be illustrated by the following typical route from San Francisco to Honolulu, to Guam, to Manila, to Hong Kong, to Yokohoma, to Vladivostok and return to San Francisco; a total of approximately 15,310 nautical miles. . . .

. . . "The average fuel economy of a Nordberg Diesel propelled vessel, the *Emory Victory* of 6000 shp. maintaining 15.5 knots, showed an overall fuel consumption of .39 lbs. per shp. per hour for all purposes and about 2.25 miles per bbl. The total fuel required for the above route of a little over 15,000 miles is 6800 bbls. or 990 tons. Similarly in service, a Victory type steam propelled vessel maintaining 15.5 knots shows about .6 lbs. per shp. hour for all purposes and about 1.33 miles per bbl. average. This steam propelled vessel therefore will require 11,500 bbls. of fuel or 1770 tons. I used a weight of 7¾ lbs. per gal. for Diesel fuel and 8¼ lbs. per gal. for boiler fuel. There is a saving of 780 tons of oil fuel in favor of the Diesel which means dollars in the pockets of the ship owner when converted into shipping tons, or by taking advantage of the savings in fuel a somewhat smaller ship can be built and still carry the same pay load.

"The engines in the *Emory Victory* are designed to use heavy fuel oil and Pacific specification number 300 is most suitable and can be obtained at San Francisco for $1.60 per bbl. and the cost of the fuel therefore would be $10,900 per trip. The Victory turbine ship using boiler oil at $1.40 per bbl. at San Francisco costs $16,200 per trip for fuel. In other words, the speeds being the same, 15-16 knots, the turbine propelled vessel would use 780 tons more fuel than the Diesel, and the cost of fuel even with the price difference would exceed the fuel cost of the Diesel by $5,300 per trip.

"C-1 vessels Diesel propelled of 4000 shp. show in actual service 2.7 to 3.56 miles per bbl. against 1.26 to 2.07 for steamers.

. . . "Although Sweden lost over 200 ships during the war, it is reported her fleet has already passed its pre-war total of 1,600,000 gross tons with more under construction."

The meeting was ably and forcefully summed up by Gordon Lefebvre, President Cooper-Bessemer Corporation who then conducted a question and answer period. Mr. Lefebvre emphasized the fact that American-made Diesels are the best available in the world today. He stated that as a result of the war we have thousands of young men who were trained by the armed forces to operate and maintain Diesel engines and are ready and eager to go to work wherever Diesels are used. Mr. Lefebvre warned the group that foreign competition is taking business away from this country in the marine field and it is being done by means of Diesel engines—he further stated that in order to recapture and hold its position, the American merchant marine industry needs to capitalize the advantages of Marine Diesels.

Gordon Lefebvre

As a genuine contribution to the success of the meeting George W. Codrington, Vice President of General Motors Corporation and head of the Cleveland Diesel Engine Division, arranged for the showing of the moving picture, "The Modern Mariner," in which the old and the new in marine design are dramatically contrasted and the marine Diesel story is vividly portrayed. Incidentally, copies of this film may be secured by writing George Codrington.

All in all the meeting was most successful in bringing closer together two groups who can do much toward furthering our American merchant marine program and marine Dieselization. Due credit should be extended to Harvey T. Hill, Executive Director of Diesel Engine Manufacturers Association, and his able assistant, Harold D. Ellis. These two men worked unceasingly to organize and carry through what turned out to be a highly successful and useful meeting.

FISHERMAN'S LUCK AND THE DIESEL

By WILL H. FULLERTON

WHEN the shrimp boats come in from the Gulf of Mexico and glide down the Freeport channel after two or three days shrimping, Captain Carl Muchowich heaves a sigh of relief. He remembers the days when he first started his business. That was in 1929 when he started his rather uncertain business of gathering the wary shrimp. He had one boat and a small one at that. Now with a fleet of 11 trawlers plus a new one on the ways, and a complete shrimp processing plant which can pack 3,000 pounds of shrimp per hour, he looks for new fields to conquer. His most recent discovery was the Diesel engine. "Captain Carl," as he is called by his men, was having trouble with the engines in his boats, and he decided to remedy his trouble. One day he dropped in to the Houston offices of Stewart and Stevenson, distributors of General Motors Diesels and had a chat with Joe Manning, General Manager of the firm. That chat resulted in an engine conversion program that now has covered seven of Captain Carl's boats. The skippers of these boats do not hesitate to praise their Diesels. They cite dependability as one of the greatest assets of their modern Diesels. The management approves of their fuel economy as well as their dependability. As well as supplying propulsion, the Diesels supply power for the booms and winches used in net handling aboard the boats.

In the operation of his business Captain Muchowich is aided by his two sons, Joseph and Raymond. Joe ably handles the operations of the shrimp fleet as far as maintenance and schedules are concerned. Raymond handles the production end of the business. He sees that the boats are iced, that the shrimp is handled properly when it arrives, and that it is quickly sold once it is processed.

The operations have grown in 17 years to include a 500-foot loading dock on the old Brazos River, just a few blocks from the business section of fast-growing Freeport. The gear lockers, offices, refrigerators, and processing plant are housed in a modern, white frame building. This building is floored with concrete, extends over 100 feet in length, and has a ramp leading down to the loading dock. With Mexican labor, the processing plant handles over 3,000 pounds of shrimp per hour.

Captain Muchowich plans to install two-way radios on all his boats as soon as the equipment becomes available. This addition should contribute greatly to the safety and efficiency of each boat, since it would be a simple matter for one boat to relay weather or fishing information to another.

Captain Carl's new boat *Evelyn M.* is now half completed. When she is finished, she will be the pride of Captain Muchowich's Diesel fleet.

George Norton (center), skipper of the "Pearl M.," talks it over with Charles Ames (left), Stewart and Stevenson Representative, and Raymond Muchowich (right), son of the owner.

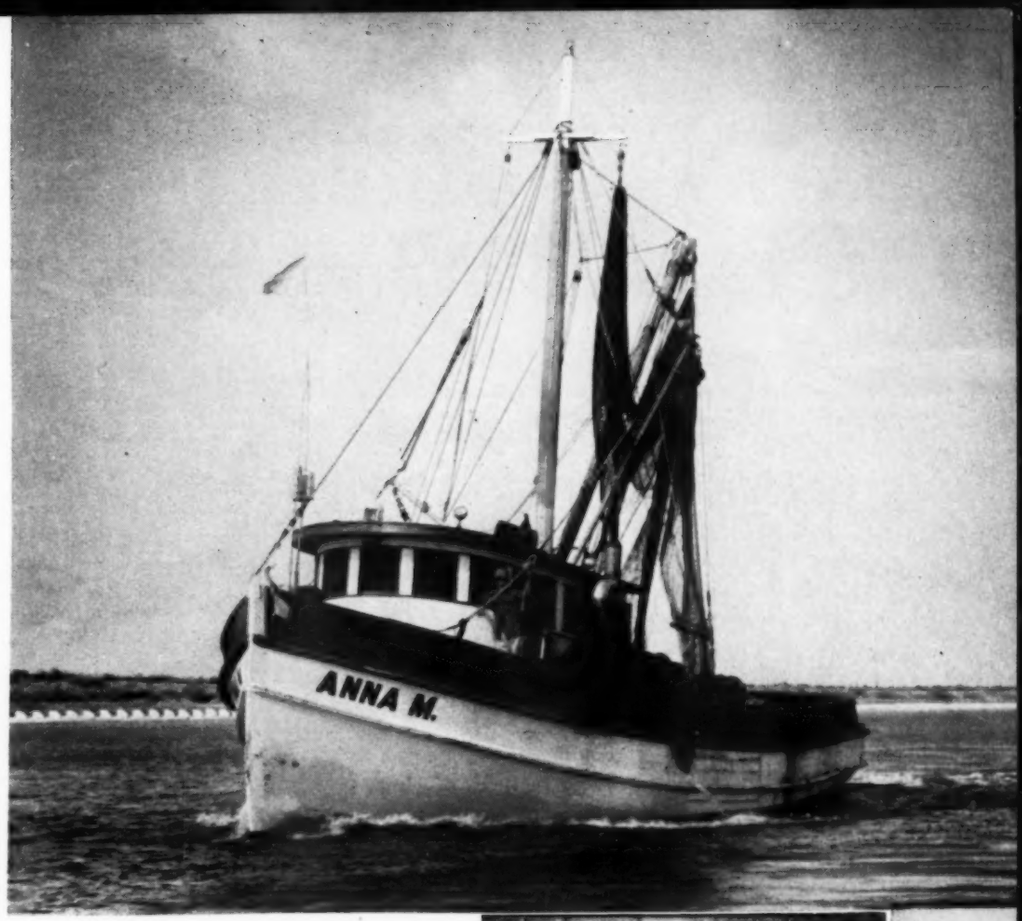
The business was started back in 1929 by Captain Carl who came to this country in 1903 from Poland. When he arrived in Texas a year later, he couldn't speak, read, or write English. These seemingly important handicaps were soon overcome and by self-teaching, Captain Carl mastered the English language. Today he is a full-fledged American with only a slight tang of Polish in his verbal English. His boundless energy is contagious and the results of this energy are apparent in the attitude of those who run his boats and work for him in the other departments of his business.

Captain Carl's trawlers are equipped with galley and bunks so that they can stay out a week if necessary. Most of them average three days on a run, with some of the smaller boats making only one-day runs. Captain Muchowich, who has the eyes of a stoic after 17 years of taking the fat with the lean in the uncharted business of gathering shrimp from the Gulf of Mexico, sends his fleet as far out as the 18 fathom curve. His fishing territory extends eastward to Sabine Pass and westward to Brownsville.

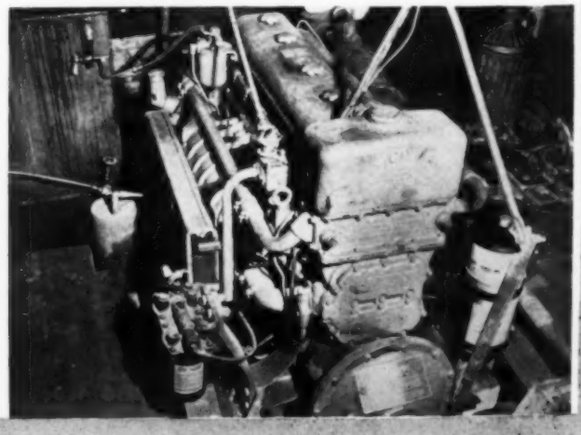
The first commercial fisherman licensed in the free city of Freeport, Captain Carl has come a long way from the uncertain early days when his little boat chugged out to the sea-buoy of the Freeport channel. Those were the days when the daily catch was vitally important and the wary shrimp and the unruly Gulf sometimes conspired against him and sent him back with his shrimp holds empty.

Now with his eleven boats captained by able skippers, Captain Carl's worries have eased considerably. He is looking forward to ever increasing prosperity. Plans for expansion in the production and distribution of shrimp are in the offing, but due to the present large demand for shrimp in Texas, all the catch is sold within the state including a large part which is quick frozen.

Captain Carl and his two sons have an enviable record as fleet operators. Their future is bright, and their ambitions are high. They have dependable men and dependable boats. All they need now, something which all fishermen will always need, is fisherman's luck.



"Anna M." stands out to the Gulf, loaded with ice and groceries for a four-day shrimp hunt. This 62-foot trawler is powered by a General Motors Diesel. (Right) Captain Carl Muchowich, hardworking owner of Muchowich and Sons.



(Left) Six of the Muchowich trawlers alongside the company dock. Long white building houses shrimp processing plant. (Right) Typical General Motors Diesel installation aboard one of the shrimp boats.

BALDWIN COMPLETES FIRST DIESEL COMMUTER LOCOMOTIVE

By WILBUR W. YOUNG

NEW developments in Diesel-electric locomotive design and usage are coming along thick and fast. Among the latest to be announced is Baldwin's new 2000 hp. double-ended Diesel-electric, the first of three units destined for commuter service on the Jersey Central Lines. It is heralded as the first Diesel-electric locomotive specifically designed for commuter service. Although Baldwin Locomotive Works has supplied better than 500 locomotives to the Jersey Central Lines, this is the first Diesel-electric passenger unit to be acquired by this railroad. Jersey Central was, however, the first railroad to use a Diesel-electric switcher, having placed one in its Bronx (N. Y.) terminal in 1925. This unit is still in use and thirty more Diesel-electric switchers have since been added to Jersey Central's motive power equipment.

In accepting the new commuter unit from President Ralph Kelly of Baldwin Locomotive Works at an impressive ceremony on November 6, last, William Wyer, Chief Executive Officer of the Central Railroad of New Jersey, made some poignant remarks. Said he, in part: "—— the use of the new Diesel-electric locomotive marks the beginning of the Jersey Central Line's independence from the use of bituminous coal——."

Pointing out that the Jersey Central and other railroads were forced to curtail operations earlier this year because of fuel shortages brought about by a nation wide strike in the soft coal mines and that now another crippling strike in the bituminous fields is threatened, Mr. Wyer continued:

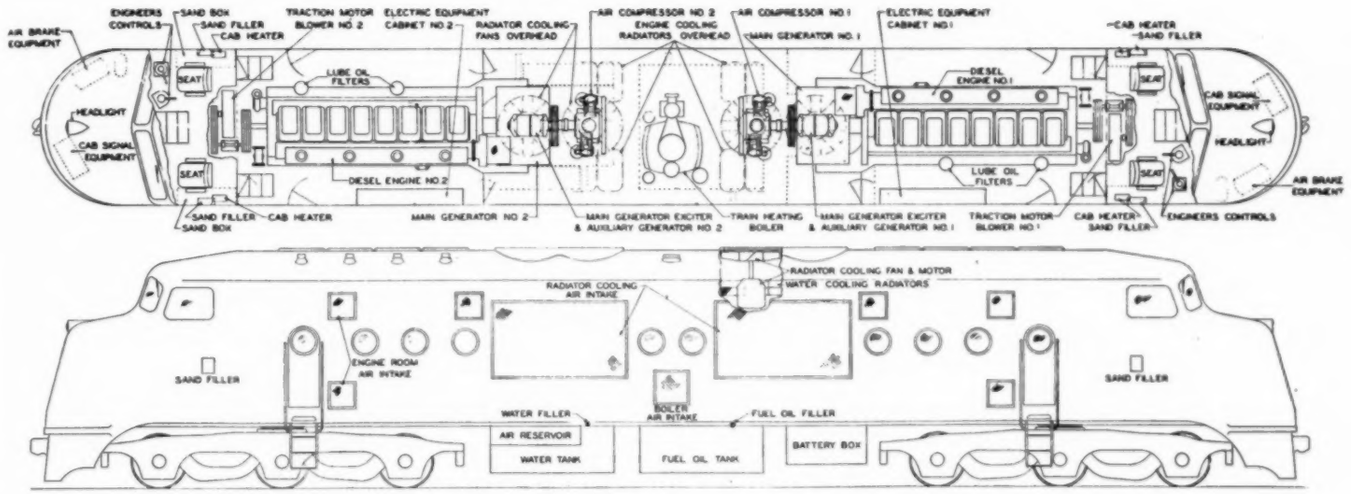
"The aim of the Jersey Central Lines management is to give the railroad complete independence from the use of bituminous coal and we will continue to replace bituminous burning locomotives with oil-burning Diesel-electric locomotives as rapidly as possible.

"We are sympathetic with the difficulties of our friends in the bituminous coal industry, but patrons cannot and will not be placed at the mercy of the whims of any man who decides to call a strike in the soft coal mines when it suits his fancy. This condition has prevailed too frequently in the past, but it is going to end as far as the Jersey Central and its operations are concerned."

In support of these comments Wyer announced that two more of commuter units are on order, scheduled for delivery before the end of the year, and Jersey Central also has ten Diesel road freight locomotives on order.

The new locomotive will be named for Frank L. Perkins, a passenger trainman on the Jersey Central Lines from July 9, 1929 until he enlisted in the U. S. Navy on April 13, 1943. Perkins was killed on June 6, 1944 during the invasion of Normandy. The next two com-

The new 2000 hp. Baldwin Commuter-type Diesel-electric locomotive seen just before being delivered to the Jersey Central Lines.



Plan and side elevation of the Baldwin Commuter Locomotive showing arrangement of the two 1000 hp. Diesels.

muter locomotives will be named the "Joseph P. Tarpey" and the "Elmer F. Shinn" respectively, in honor of these two former employes of the Jersey Central Lines.

Provided with an operator's cab and complete controls at both ends, thus making possible its operation in either direction without the necessity of turning at terminals, the locomotive was displayed resplendent in Jersey Central Colors, blue, tangerine and orange. Its length inside coupler knuckles is 80 ft. and it carries two Baldwin 8 cylinder, 12¾ x 15½, Diesels each rated 1000 bhp. at 625 rpm. The engines are fitted with Alnor pyrometers, Woodward governors and Detroit lubricator lube pressure and water temperature safety controls. Generators, traction motors and electric transmission and controls are all Westinghouse. A Vapor Car Heating boiler of 2250 lbs.-per-hour capacity is fitted midships between the two generators. Engine supplies carried include 1500 gals. of fuel oil, 380 gals. of lube oil and 600 gals. of engine cooling water. The locomotive in working order weighs 375,000 lbs.

Jersey Central commuters will soon enjoy fast, smooth, clean rides behind their new motive power equipment—in fact as Mr. Wyer pointed out, this is essentially an electric locomotive which carries its own prime power plant thus eliminating the vicissitudes of central power generation and extensive transmission lines.

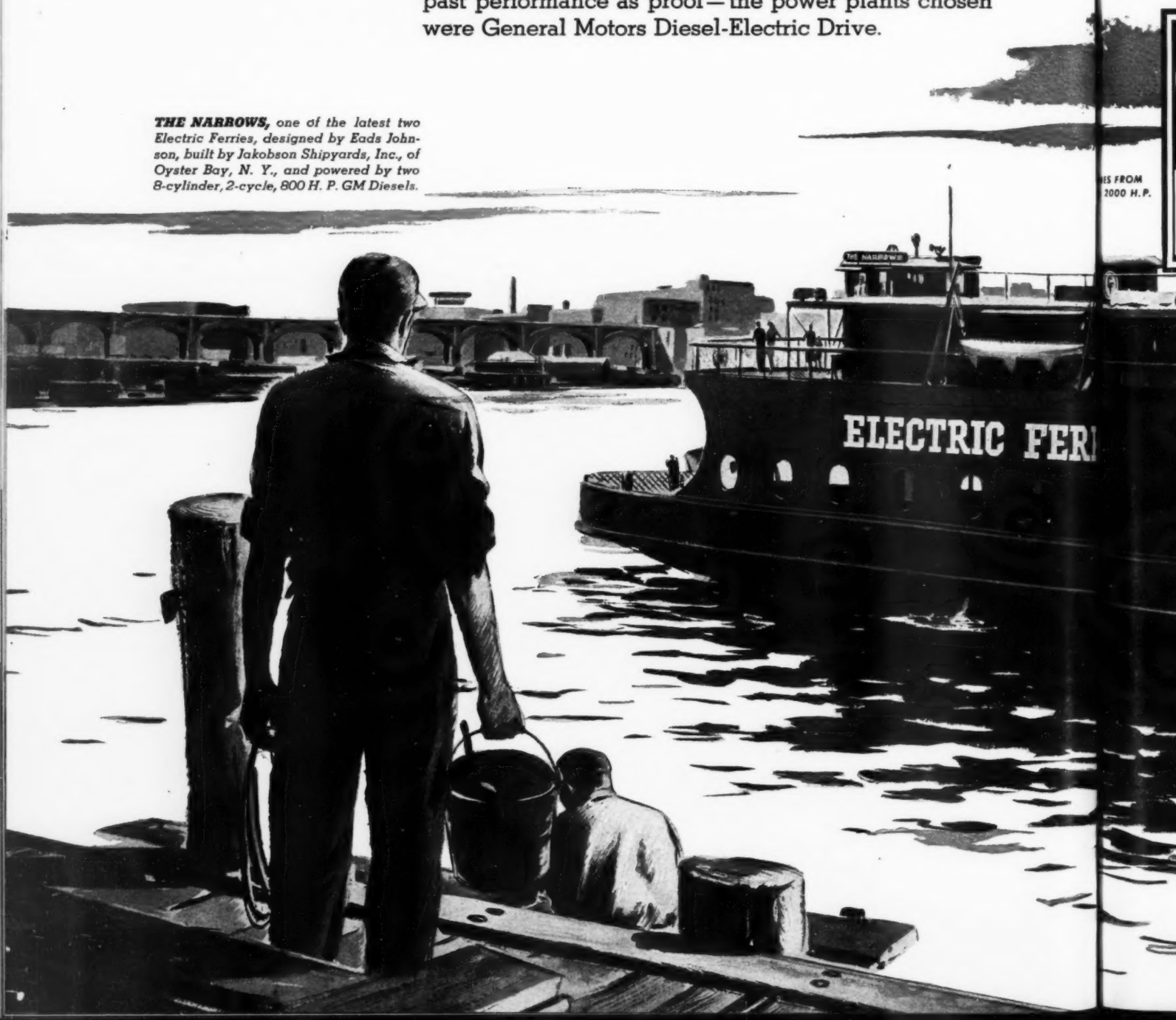
President Ralph Kelly of Baldwin Locomotive Works, seen lower left corner of platform, addressing Jersey Central officials and guests.

Two more join the le

Shuttling back and forth, day and night, on important runs in New York waters is the well-known fleet of Electric Ferries, Inc.

Recently two new ferries have been put into service.

With dependability a prime consideration—and with past performance as proof—the power plants chosen were General Motors Diesel-Electric Drive.



THE NARROWS, *one of the latest two Electric Ferries, designed by Eads Johnson, built by Jakobson Shipyards, Inc., of Oyster Bay, N. Y., and powered by two 8-cylinder, 2-cycle, 800 H. P. GM Diesels.*

ES FROM
2000 H.P.

GM
GENERAL MOTORS
DIESEL
POWER
CLEVELAND DIESEL ENGINE DIVISION
CLEVELAND 11, OHIO
GENERAL MOTORS
THE NARROWS
THE NARROWS

OIL GOES BACK TO THE FARM

By F. HAL HIGGINS

OUT of the good earth came oil's products and prosperity, and back to the farm is going a lot of its products for the future. So it looked to your Old Reporter as he met and listened to the members of the newly-formed Agricultural Development Committee of the American Petroleum Institute, following its 3-day session in San Francisco when they were guests of the California Tractor and Implement Club at dinner recently. The next day, we all piled into autos and trekked over to the heart of the San Joaquin Valley to visit Shell Oil Company's new half million-dollar Farm Laboratory. These fellows were "sharp" on this farm field and their impact is going to be immediate, effective and far reaching.

First, let's look at the Who's Who of this Agricultural Development Committee. George Krieger of the Ethyl Corporation is the chairman in charge of the overall program.

The even dozen members of the Agricultural Development Committee who held its first west coast meeting in San Francisco, September 17 to 19 were addressed by the leading California farm authorities. President Ray Wiser of the California State Farm Bureau Federation; Prof. H. B. Walker, head of the Agricultural Engineering Division of the University of California; Jesse W. Tapp, vice-president of the Bank of America; Ray H. Nagle, director of the U. S. Department of Agriculture Regional Research Laboratory at Albany, Calif., were some of the top flight speakers. Prof. Walker gave them a dramatic word picture of their field including more and bigger Diesels in agriculture; more airplane farming for seeding, weeding, fertilizing and bug swatting. He pointed out that here in California is every problem of variety of crops, soils and climate for the oil men to work on in helping themselves and agriculture at the same time.

George Krieger of the Ethyl Corporation, who was present as national chairman of the development committee, noted that the U. S. farmer now owns 2,200,000 tractors and expects to add another 200,000 tractors a year for the next five years to bring this number up to over 3,000,000. Flame weeding, defoliation of cotton for machine picking, tobacco curing, hay drying, wood preserving, not to overlook the billions of dollars in roads and streets to be built yet, make the oil field loom bigger and bigger on the horizon.

Shell left no doubt in the minds of visitors to its official opening that it is leading the parade of oil companies into agriculture. One veteran old-school farmer who came over to see what was cooking in this new half million-dollar lab summed it up after trailing the 600 "Drs.," "Profs," County Advisors, and oil officials around the farm: "Just a high-toned way of doin' what we used to do with horse manure and water!"

The staff of 36 men and women scientists the visitors met at the laboratory was the big eye-opener. Probably no U. S. State Agricultural College ever started with such a carefully picked and well paid staff of workers to do a job. There are chemists, an agricultural engineer, a horticulturist, an entomologist, a nematologist, a plant physiologist, a plant pathologist, and so on through the special fields touching fruit, vegetable, field and other crops where oil field and laboratory products and by-products may fit into the picture. Shell has opened up a big fertilizer field for its nitrogen taken from the air at its plant at Pittsburg where the writer recalls Caterpillar tractors working on the ground for the first buildings nearly 18 years ago. All up and down the Coast one runs into Shell service trucks unloading cylinders and hooking them up to pour this crop necessity into the irrigation water of orchard or row crop. It's a service that has proved itself to the fertilizer-conscious farmer who no longer has to be sold on the idea that manure must come out of a barn from under cows, horses or other live stock.

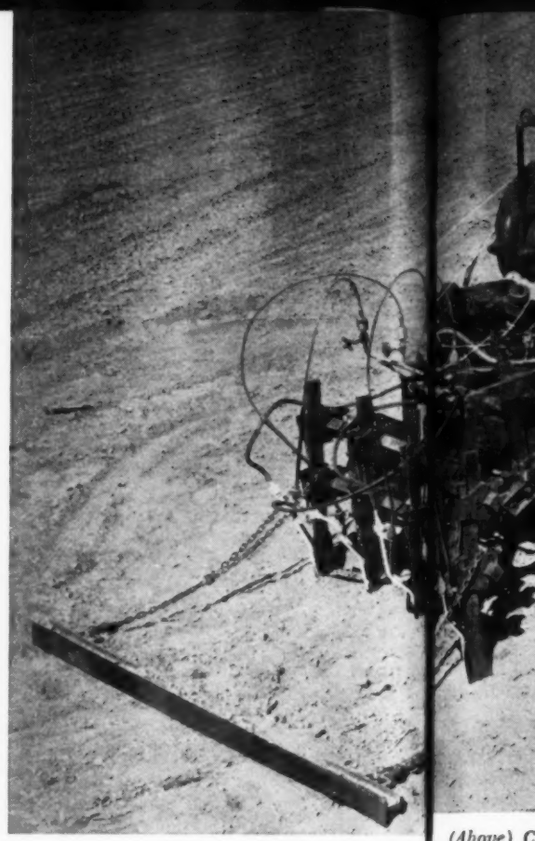
Dr. Roy Hansberry who heads the new Shell farm lab, is a graduate of Washington State College with a lot of work in Iowa, Illinois, Missouri and New York. He took pardonable pride in showing his distinguished visitors around his new premises. Said Hansberry:

"Our laboratory was built to contribute to the advancement of agriculture. In our search for better agricultural chemicals from petroleum we sometimes improve old methods of farming, and occasionally we find new ones. The sciences of plant nutrition and pest control have widened the farmer's horizons. As his needs broaden to include new materials for controlling pests and regulating the growth of plants, Shell's agricultural laboratory stands ready to fill those needs with chemicals tested and developed in laboratory, greenhouse and field.

"We who work in this new laboratory have joined Shell's research staff because of a common interest in scientific agriculture. Our purpose is to plow straight furrows in the field of agricultural science."

Recognizing the agriculturist's growing need of better oil sprays and chemical aids, Shell has opened a modern agricultural laboratory and experimental station in California, seven miles from Modesto. The laboratory has a three-fold purpose. Most important, it is a research institution for development of new ideas; it is also a proving ground for natural and synthetic products derived from petroleum; and it is a clearing house of scientific knowledge and information where farmers' problems may be presented and solved.

The farm itself is of sufficient size to permit field testing on a commercial scale. The location at Modesto was selected because of its suit-



(Above) C
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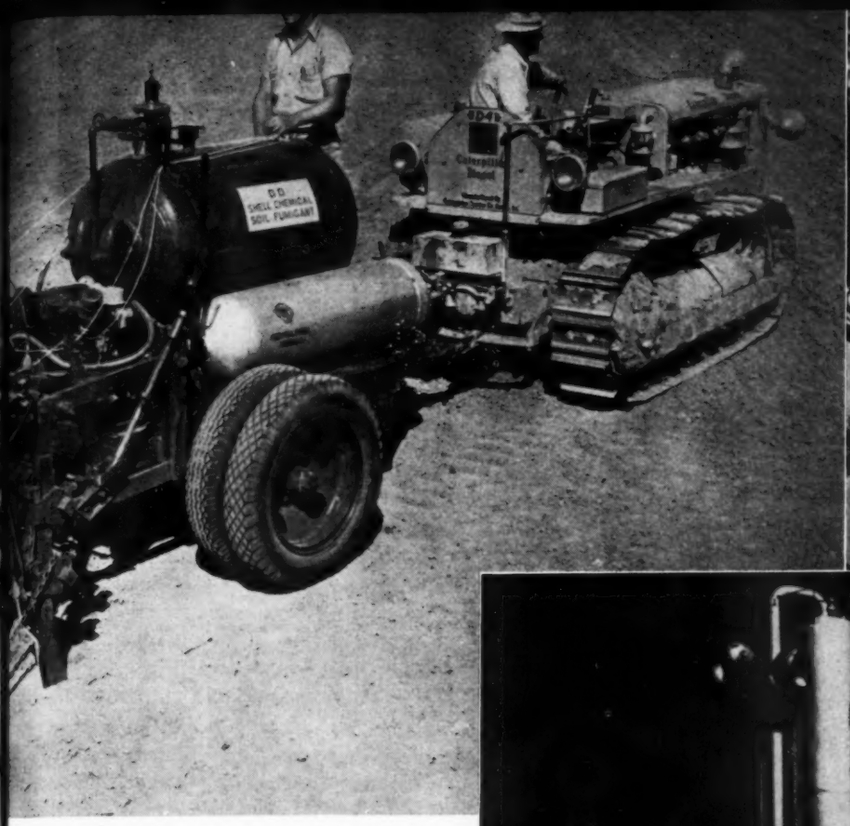
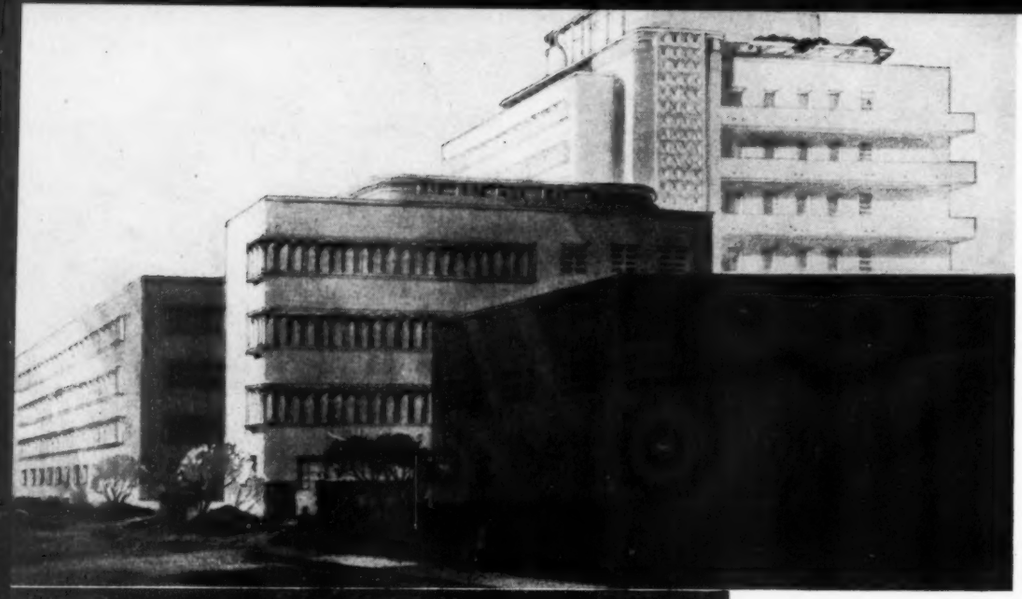


(Above) Caterpillar Diesel tractor pulling soil fertilizing and cleaning rig at the new laboratory farm. (Above, right) Dr. Roy Hansberry, Director of the Shell Farm Laboratory. (Right) Near Pittsburg, California is Shell's refinery where farm products are manufactured. (Bottom, right) Air view of the Shell farm near Modesto, California.

ability for growing the wide range of crops needed in the research program. The projected planting will provide 100 acres of trees and vines of all commercial types and 30 acres of truck crops. The remaining 12 acres are utilized by the buildings and improved roads which divide the two areas into blocks for convenient experimental use.

The property was purchased in July, 1944, and in September, 1945, ground was broken for the new laboratory. Other buildings and service units, including ranch houses, implement storage and warehouses, and a fruit handling building, will be constructed when materials are available. The farm has been improved by clearing 50 acres of old fruit and nut trees, re-leveling the land and by installation of an underground concrete-pipe irrigation system. More than $500,000 have been invested in the project.

In order to cover the broad field of agricultural science, the laboratory staff has been selected on the basis of specialized training and experience in the fields of horticulture, entomology, plant physiology, plant pathology,



(Above) Shell's proposed 3,000,000 dollar building program includes this plant to be built at Emeryville, California.

(Left) Soil experts releasing nitrogen into the soil. Selling nitrogen has become a big business for Shell.

nematology, agricultural engineering and soils. There are approximately 30 people on the staff including the scientists, technical assistants, library and office personnel. In addition, twelve to fifteen ranch workers are employed to operate the farm on a modern scientific basis.

The research staff is organized to provide for the issuance of monthly and final reports on each experiment, with recommendations and conclusions. This information goes to the manufacturing and marketing departments of Shell where it is used in studying the possibilities of commercial development.

Although the petroleum industry has already been of service to the nation's farmers in many ways, both the industry and progressive growers realize that, as yet, only the surface has been scratched in the development of new chemical products of benefit to agriculture. Many problems have still to be solved, and more efficient chemicals must be found and put to work.

That Shell has been working on a long range program for some years is seen in its statement of the coordinated activities of its Oil, Development and Chemical companies and corporation in finally coordinating all three in this activity just opened at Modesto for Agriculture:

The close-knit relationship of these three companies in producing useful chemicals for the farmer is demonstrated by the movement of chemical products through Shell's various phases of development. In the Emeryville laboratory of Shell Development Company, staffed by nearly 1200 persons, work is constantly under way synthesizing new chemicals and developing processes for their efficient manufacture.

From these laboratories have already come many products that either have known value to the farmer or are ready for testing. It is the task of the scientists at the agricultural laboratory to investigate these products and find the best applications for them. Once proved, they are produced by the manufacturing departments and distributed by the marketing divisions of Shell Oil Company and Shell Chemical Corporation.

The agricultural laboratory thus rounds out the experimental, manufacturing, and marketing programs of Shell. As an integral and important part of Shell's organization it completes a cycle of endeavor that is directed toward producing more useful agricultural chemicals at reduced cost to the grower. This is additional evidence of the sharp trend toward the development through sound research of new and better agricultural chemicals.

Shell's laboratory at Modesto has been established not only to help solve the many sectional and regional problems confronting the agricultural industry, but as an aid to the individual farmer.

The organization required to accomplish close liaison between the farmer and the laboratory is made up of experienced agricultural technologists, maintained in the field by the marketing departments of Shell Oil Company and Shell Chemical Corporation. These men are assigned to specific geographical areas in productive farming communities throughout the United States and their most important responsibility is to offer, in effect, a local consulting service.

Through their frequent visits with farmers, representatives of federal and state experimental stations, and the personnel of state and county extension services, Shell's technologists maintain a two-way flow of information between the laboratory and the grower. These technologists also undertake large-scale field testing of new products—frequently on a cooperative basis with government authorities—prior to introducing them to the growers.

Through the efforts of the laboratory staff aided by employees of the other extensive facilities of Shell, new products and improved methods are made available to individual farmers as quickly as laboratory and field trials prove that these new products are ready for practical commercial use.

SUPERCHARGING AND INTERNAL COOLING CYCLE FOR HIGH OUTPUT

By R. H. MILLER*

It is now well known that reduction of the temperature of a charge before compression in an engine is far more effective as a means of increasing the output than is an increase of the pressure. By example and diagram the author shows the gains which may be made by supercharging with and without intercooling the charge in the inlet manifold. He then discusses the dual-pressure supercharging cycle, and high-pressure supercharging with high combustion pressures. It has been determined that by selection of blower-discharge pressure and proper timing of the inlet-valve closing, engines equipped with the dual-pressure supercharging system will carry full sea-level rating at all altitudes.

IN 1923, while engaged as experimental engineer on the development of this country's first engine for Diesel locomotives, the author in collaboration with Dr. Sanford Moss, applied an exhaust-gas turbocharger to a 6-cylinder 10 x 12 in. 600 rpm. Diesel engine. The results were most discouraging in that the engine would carry less load with the turbocharger than without it.

As often happens in engineering, lack of determination and a failure to visualize the tremendous possibilities of our pioneer work caused the project to be dropped after this first attempt. Nothing was known about valve overlap or the effect of scavenging. A test engineer who at that time suggested cooling the air before admitting it to the inlet manifold was 20 years ahead of the time, and the idea was rejected with the "obvious" explanation that a heat engine could not be improved by removing heat from the charge.

*Chief Engineer, Four Cycle Diesel Division, Nordberg Manufacturing Company. Mem. A.S.M.E.

NOTE: Statements and opinions advanced in papers are to be understood as individual expressions of their authors and not those of the Society.

Theoretical analysis, verified by actual engine tests, shows that reduction of the temperature of the charge before compression in the engine is far more effective as a means of increasing the output than is an increase of the pressure.

The conception that excess air is required to sustain combustion is based upon false premises. The excess air serves only to dilute the products of combustion and so limit the temperature of the mixture. This is proved in the gas turbine where the excess air is added after combustion.

It is obvious that the lower the temperature of the excess air the less is needed to hold the mixture of combustion product and excess air to a given limiting temperature.

In Fig. 1 are shown two P-V diagrams superimposed. For the sake of simplicity, the combustion is assumed to take place at constant volume. The compression and expansion exponents are assumed to be 1.33 and 1.3, respectively, and the compression volume ratio 13. The pressures and temperatures are shown in the table. Diagram A has an initial compression pressure and temperature of 6 psig and 605 deg. R, and diagram B 20 psig and 815 deg. R.

The combustion-pressure rise in diagram A is chosen to give 134 mip which has a maximum combustion temperature of 3250 deg. R. The combustion rise in diagram B has been selected to give the same maximum temperature of 3250 deg. R. This gives a mip of 129.5 psi for diagram B.

The weight of the air in the cylinder for diagram B is 1.24 times greater than in diagram A, due to the higher pressure.

Thus in this example, when increasing the weight of air 24 per cent the mip decreases 3.5 per cent for the same maximum combustion temperature, and diagram A operates with less excess air than B. On the basis of equal cycle mean temperature the load on diagram B would actually be reduced 25 per cent instead of 3.5 per cent.

In Fig. 2 three diagrams have been superimposed as follows:

Diagram A (solid lines), nonsupercharged
Mip = 94.5 psi
Diagram B (dash lines), supercharged to 4 psig

$$\text{Mip} = 94.5 \times \frac{18.7}{14.7} = 120 \text{ psi}$$

Diagram C (dot-and-dash lines), nonsupercharged
Mip = 156 psi

These diagrams are plotted with the following

Compression exponent $k_1 = 1.33$
Expansion exponent $k_2 = 1.45$

The mip may be calculated from the following formula

$$\text{Mip} = \frac{1}{R-1}\left[\frac{R(P_4C - P_5)}{k_2 - 1} + (P_4 \times C \times R - P_2) - \frac{P_2 - P_1 \times R}{k_1 - 1}\right] \quad \ldots[1]$$

where R = compression volume ratio
C = volume at cut-off divided by total volume
P_1 = pressure at beginning of compression psia
P_2 = compression pressure psia
P_3 and P_4 = combustion pressure psia
P_5 = pressure at end of expansion psia
Mip = indicated mean effective pressure psi

In diagram B all pressures are $\frac{18.7}{14.7}$ times greater than in the nonsupercharged diagram A. Equation [1] shows that with the same cut-off C = 0.112, the mip is increased in the same ratio as P_1 or from 94.5 to 120 psi.

It also follows from this equation

$$PV = WRT \quad \ldots[2]$$

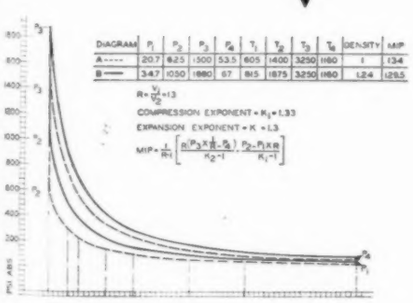
that the temperatures in any piston position are the same in diagrams A and B if both start with the same initial compression temperature T_1. The cycle mean temperatures of diagrams A and B are therefore identical. Diagram C is plotted with cut-off 0.15 which is selected to give the same cycle mean temperature as in A and B when the initial compression temperature is lowered to produce the same air-density increase as from A to B

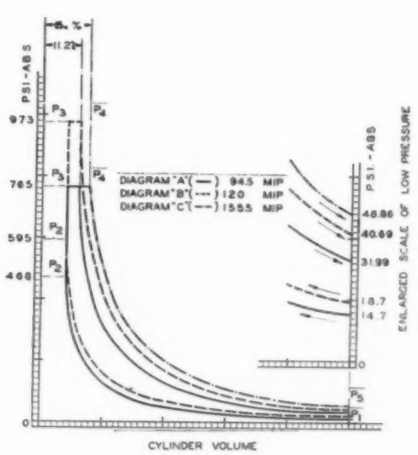
$$\left(\frac{18.7}{14.7} = 1.27\right), \text{ that is } T_{1C} = T_{1AB} \times \frac{14.7}{18.7} \quad \ldots[3]$$

If we assume

FIGURE 1 →

FIGURE 2 ↓





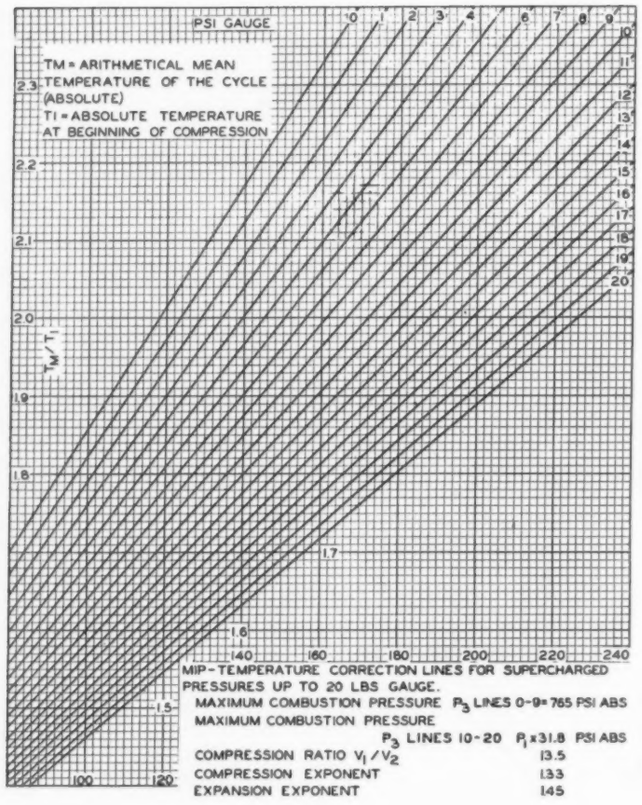

PSI GAUGE
TM = ARITHMETICAL MEAN TEMPERATURE OF THE CYCLE (ABSOLUTE)
TI = ABSOLUTE TEMPERATURE AT BEGINNING OF COMPRESSION
TM / TI
MIP - TEMPERATURE CORRECTION LINES FOR SUPERCHARGED PRESSURES UP TO 20 LBS GAUGE.
MAXIMUM COMBUSTION PRESSURE P3 LINES 0-9 = 765 PSI ABS
MAXIMUM COMBUSTION PRESSURE P3 LINES 10-20 P1 x 31.8 PSI ABS
COMPRESSION RATIO V1 / V2 13.5
COMPRESSION EXPONENT 1.33
EXPANSION EXPONENT 1.45

FIGURE 3

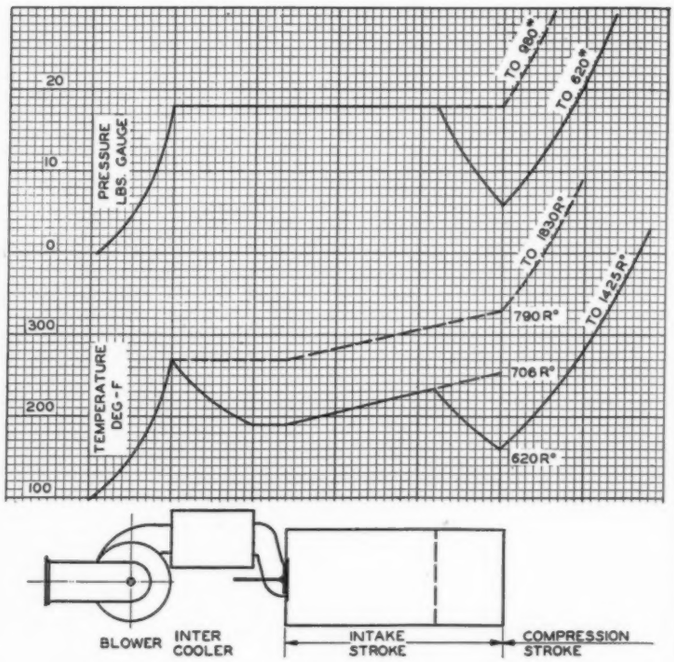


FIGURE 4

then

$$T_{1.45} = 695 \text{ deg. R. (235 deg. F.)}$$

$$T_{1.0} = 546 \text{ deg. R. (86 deg. F.)}$$

By using the constant-mean-temperature chart in Fig. 3 we read on the zero pressure line for diagram A

T_m/T_1 ratio for 94.5 mip = 1.815

then

$$T_m = 695 \times 1.815 = 1260 \text{ deg. R.}$$

and diagram C with initial compression temperature $T_1 = 546$ deg. R.

$$T_m/T_1 = \frac{1260}{546} = 2.3$$

Ratio 2.3 on zero gage pressure reads 156 mip. This shows that on the basis of equal internal temperatures, increasing density by cooling more than doubles the output obtained at the same density by increased pressure. The temperature selected in this example is lower than is practical in engines with conventional compression ratios, but has been used to show the relative effect of pressure and temperature on engine output.

An example applicable to present-day designs with compression ratios of about 13 to 1 might be as follows:

Example 1. An engine operating supercharged at 4 psig without intercooling at 130 psi mip shows a T_m/T_1 ratio of 1.935 on the 4-psi line in Fig. 3.

The initial compression temperature T_1 may be set up as follows:

Atmospheric temperature (assumed) = 90 F.
Heating in blower = 55 F.
Cylinder heating = 65 F.

Then

$$T_1 = 670 \text{ deg. R.}$$

and

$$T_m = 670 \times 1.935 = 1296 \text{ deg. R.}$$

If now the air is intercooled to 90 deg. F. in the inlet manifold, we have

$$T_1 = 670 - 55 = 615 \text{ deg. R.}$$

and

$$T_m/T_1 = \frac{1296}{615} = 2.108$$

This increases the mip to 155.5 psi.

Had the manifold temperature been cooled to 65 F., bringing T_1 to 590 deg. R, the T_m/T_1 ratio would increase to 2.2 and the mip to 169, Fig. 3.

Cooling air at 65 or even 90 F. is practical only where cold water is available, and in the transportation field where atmospheric air is the only cooling medium, such low temperatures cannot be obtained in the conventional supercharging system without the use of refrigerating equipment.

Dual-Pressure Supercharging Cycle

This cycle is designed to produce internal cooling by expansion from a high pressure to a lower pressure and temperature. In this system the initial compression temperature will be

$$T_1 = T_{CL} + t_{ch} - t_{ea} \quad \ldots\ldots\ldots [4]$$

where T_{CL} = temperature of air leaving intercooler, deg. R.

t_{ch} = heating of air in cylinder during full down stroke of piston

t_{ea} = adiabatic temperature drop for expansion from manifold pressure (P_m) to pressure at end of down stroke (P_1)

A diagram has been drawn in Fig. 4 to show the pressure and temperature path of the air up to the beginning of the compression stroke. For comparison, the conventional supercharging system is shown in dotted lines. In the latter T_1 is equal to the manifold temperature plus cylinder heating or

$$T_1 = T_{CL} + t_{ch} \quad \ldots\ldots\ldots [5]$$

Expansion cooling therefore accomplishes lower initial compression temperatures (T_1) with the same manifold temperatures, Equation [4].

Thus in Example 1, where the manifold temperature was cooled to 90 F. to obtain a rating of 155.5 mip, the same initial compression temperature ($T_1 = 615$ deg. R) could be obtained by cooling the manifold to only 130 F. by so selecting the expansion ratio that $t_{ea} = (130 - 90) = 40$ F. With a required supercharging pressure of 4 psig, the blower discharge or manifold pressure would then be 8.65 psig.

$$t_{ea} = 40 = 615 \times \left[\left(\frac{P_m}{P_1}\right)^{0.283} - 1\right]$$

where P_m = manifold pressure = 23.35 psia
P_1 = supercharging pressure = 18.7 psia
t_{ea} = adiabatic temperature drop = 40 F.

With the assumed cylinder heating of 65 deg. F. during the combined 180-deg. crank angle of the combined suction and expansion, the exponent for the latter function would be $n = 1.15$. The inlet valve would therefore be timed to close about 60 deg. before bottom dead center to expand from 8.65 to 4 psig.

Pressures, temperatures, and expansion ratios other than those shown in the examples can obviously be used.

Increasing the expansion ratio lowers the initial compression temperature with any given manifold temperature. Higher supercharging pressures P_1, may be selected either by increasing the manifold pressure or reducing the expansion ratio.

The pressure lines in Fig. 3 show the output in mip for all conditions of T_1 and P_1.

An engine is now being built to operate with a blower pressure of 18 psig and an expansion ratio of 1.65 giving a supercharging pressure of 5 psig. The preturbine exhaust-gas pressure will be about 14¾ psig. This pressure difference between inlet and exhaust manifold will induce complete scavenging at high engine speed with valve overlaps smaller than are now required.

The dual-pressure supercharging cycle can be operated without intercooling. The initial compression temperature T_1 with the pressures in the foregoing paragraphs would then be

$$T_1 = t_{atm} + t_{bb} + t_{eb} - t_{ee}$$

where, using values in Example 1

$$t_{atm} = 550 \text{ deg. R. (90 deg. F.)}$$

$$t_{bb} = \frac{550 \times \left[\left(\frac{23.35}{14.7}\right)^{0.283} - 1\right]}{0.75} = 103 \text{ F.}$$

$$t_{bb} = 65 \text{ F.}$$

$$t_{ee} = \left(T_{atm} + t_{bb} + \frac{t_{eb} \times 120}{180}\right)\left[1 - \frac{1}{\left(\frac{23.35}{18.7}\right)^{0.283}}\right] = 42 \text{ F.}$$

then

$$T_1 = 550 + 103 + 65 - 42 = 676 \text{ deg. R.}$$

This temperature is 9 deg. higher than obtained with supercharging to 4 psig by the conventional method without intercooling, where

$$T_1 = T_{atm} + t_{bb} + t_{eb}$$

$$T_1 = 550 + \frac{550\left[\left(\frac{18.7}{14.7}\right)^{0.283} - 1\right]}{0.75} + 65 = 667 \text{ deg. R.}$$

Had the blower efficiency been 82 per cent instead of 75 per cent, then the two T_1 temperatures would be equal at these pressure conditions. Thus it is seen that without intercooling the dual-pressure cycle and the conventional turbocharging system carry the same rating at equal supercharging pressures.

The advantage of the former is that the scavenging pressure is higher than the supercharging pressure so that the exhaust from a multiple-cylinder engine can be carried to the turbocharger in a single pipe without loss of scavenging efficiency.

Scavenging of the clearance volume is a function of time and the pressure difference between inlet and exhaust manifolds during the scavenging period. But since the scavenging time decreases with engine speed, it follows that the pressure difference must be increased with engine speed. This is a feature of the dual-pressure cycle.

With constant over-all turboblower efficiency the pressure difference between blower discharge and preturbine pressures increases with blower-discharge pressure. This is shown in Fig. 5 in which is plotted blower pressure versus blower minus preturbine pressures at 950 F. gas temperature and 90 F. blower-intake temperature for an over-all efficiency of 50 per cent.

For high-speed engines requiring 3½ psi differential pressure, a blower-discharge pressure between 20 and 25 psig would be selected.

In a slow-speed engine, where more time is available per cycle for scavenging, a differential pressure of 2 to 2½ psi is sufficient and a blower-discharge pressure of 8 to 11 psig would be selected. The inlet valve is then timed to close between 50 and 75 deg. BBC on the intake stroke to expand to a supercharging pressure of 4 psig.

Effective intercooling and internal-expansion cooling may require operating an engine with a blower pressure higher than needed for scavenging, in which case the valve-overlap angle may be reduced, or the engine can be operated with excessive scavenging if the turbine efficiency permits.

Cooling before compression is limited to the minimum compression temperature required to ignite the fuel spray. With Diesel fuel of 45-cetane rating, this temperature will be about 1000 F. which is obtained with an initial compression temperature of 615 deg. R at 14 to 1 compression ratio.

Lines 1, 2, and 3 in Fig. 6 are plotted with a constant-cycle mean temperature equal to the mean temperature in the non-supercharged engine at 100 mip and T_1 = 680 deg. R.

Line 3 shows mip versus P_1 and T_1 = 615 and $\frac{V_1}{V_2}$ = 14. The compression pressure P_2 versus P_1 is shown on line 4. The maximum combustion pressure is not plotted but will be 1.6 times the compression pressure for ratings on lines 2 and 3.

Line 1 shows mip versus P_1 when maximum combustion pressure is kept constant.

Engines of conventional design in which combustion pressures cannot exceed those existing when operating nonsupercharged are limited to an output of about 170 mip with maximum cooling of T_1 to 615 deg. R. This is about 75 per cent increase in bhp. over nonsupercharged rating.

High-Pressure Supercharging With High Combustion Pressures

Mean indicated pressure (mip) versus P_1, line 3 in Fig. 6, shows the high outputs which can be obtained in an engine designed to carry

. . . . *And now please turn to page 84* . . . .

FIGURE 5

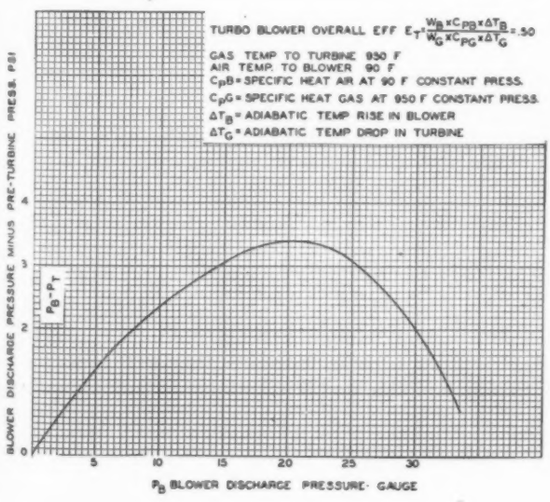
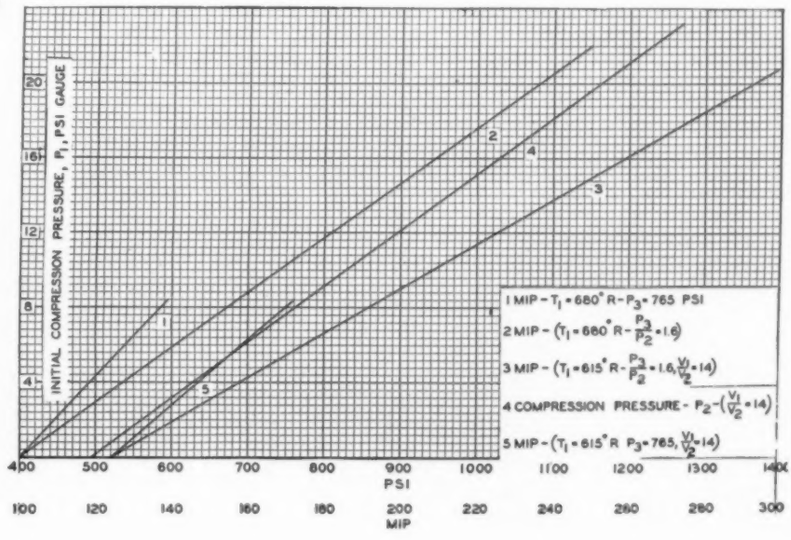

TURBO BLOWER OVERALL EFF $E_T = \frac{W_B \times C_{PB} \times \Delta T_B}{W_G \times C_{PG} \times \Delta T_G} = .50$
GAS TEMP TO TURBINE 950 F
AIR TEMP TO BLOWER 90 F
C_{pB} = SPECIFIC HEAT AIR AT 90 F CONSTANT PRESS.
C_{pG} = SPECIFIC HEAT GAS AT 950 F CONSTANT PRESS.
ΔT_B = ADIABATIC TEMP RISE IN BLOWER
ΔT_G = ADIABATIC TEMP DROP IN TURBINE
BLOWER DISCHARGE PRESSURE MINUS PRE-TURBINE PRESS. PSI
$P_B - P_T$
P_B BLOWER DISCHARGE PRESSURE - GAUGE

FIGURE 6


INITIAL COMPRESSION PRESSURE, P_1, PSI GAUGE
1 MIP - T_1 = 680° R - P_3 = 765 PSI
2 MIP - (T_1 = 680° R - $\frac{P_3}{P_2}$ = 1.6)
3 MIP - (T_1 = 615° R - $\frac{P_3}{P_2}$ = 1.6, $\frac{V_1}{V_2}$ = 14)
4 COMPRESSION PRESSURE - P_2 - ($\frac{V_1}{V_2}$ = 14)
5 MIP - (T_1 = 615° R P_3 = 765, $\frac{V_1}{V_2}$ = 14)
PSI
MIP

FARMERS NEED MORE POWER

Diesels and R.E.A. Will Supply It

By FRANKLIN P. WOOD*

SINCE the Rural Electrification Administration was established in 1935, the number of American farms electrified has jumped from fewer than 750,000 to approximately 3,100,000, or from less than 11 per cent to nearly 53 per cent of the total. Rural electric cooperatives have used REA loans to blanket the nation with rural power lines serving more than a million and a half rural consumers.

Impressive as this 11-year record of accomplishment is, REA regards it as merely a prelude to far more significant developments in rural electrification. Today, with the groundwork laid, REA is entering a new phase of its operations. While helping more farms get electric service through our loan program, we must increasingly concern ourselves with helping REA cooperatives to obtain adequate power to serve the needs of present and future consumers.

More than 380,000 new farm consumers received electric service during fiscal 1946 through expansion in the rural facilities of both REA-financed co-ops and commercial power companies. Even greater progress is foreseen as the supply of materials for line construction and farmstead wiring improves. REA-financed rural electric cooperatives, committed to the policy of area coverage electrification, have already received REA approval of plans for construction of facilities that will serve more than a million new rural consumers. They are obtaining additional line construction loans at the rate of nearly a million dollars a day.

Obviously, such a program involves an appraisal of the nation's facilities for producing power and distributing it to farmers. It would be the height of irresponsibility to encourage cooperatives to electrify more farms and to promote farm use of power unless at the same time steps were taken to assure that the power would be needed when available. That is why REA has become increasingly concerned in recent months about the nation's long-range power supply situation.

Reports received by REA from rural electric co-ops show that farmers are using electric energy on a scale that surpasses the wildest dreams of the pioneer rural electrification planners of the 1930's. During the 1946 fiscal year the REA-financed rural electric systems of the nation distributed 2,185,000,000 kilowatt hours of energy to their consumers, contrasted with 566,000,000 in fiscal 1941, although the number of consumers served only doubled during that period.

During the war years, when this increase occurred, electrical equipment was scarce. As more equipment becomes available and new farm production devices are perfected, it is apparent that consumption of electricity per rural consumer will rise even more rapidly.

Added to the power demands of present rural consumers will be the needs of perhaps five million farms and non-farm rural consumers who still lack electric service but are expected to be connected to power lines within the next few years. What the nation's rural power needs will be five or ten years from now is difficult to estimate, but it is clear that vastly increased sources of power will be required to meet them.

Already, with two and three quarter million of the nation's farms still to be electrified, it is apparent that power generation, transmission, and distribution facilities are woefully inadequate in some areas. Operating reports of REA-financed cooperatives indicate that more than 400 of the 835 co-ops that have energized their systems are unable to meet the full needs of their present consumers. The condition exists in every section of the country—in Illinois, in Pennsylvania, in Texas—in virtually every one of the 46 states where there are REA-financed lines. In some sections, the situation is so acute that it is actually delaying the construction of new rural power lines.

It is understandable that some REA-financed distribution systems should have balked at the power loads they are being asked to carry. The huge increase since 1941 in power distributed by REA co-ops has been achieved without major changes in distribution facilities that were built at a time when farmers generally were expected to use considerably less electricity than town and city people used.

As REA Administrator Claude R. Wickard recently told a group of co-op officials: "We do not need to apologize for the inadequacy of any existing REA-financed facilities serving rural areas. Our single-phase distribution systems are the best ever built for the purpose for which they were built. They have delivered and are delivering more service per dollar invested than any other rural power lines ever built. Most of these lines are giving satisfactory service but we know that they will not be adequate in many cases to carry the increased load which is coming with the electrical age in agriculture."

To meet the problem of inadequate distribution systems, REA is encouraging its borrowers to make system studies and plan now for the ultimate needs of all the consumers they expect to serve eventually. These studies involve recommendations of re-phasing, provision of additional sub-stations, relocation of sub-stations where necessary, and a variety of other system improvements. In some cases, improvements have already begun, but the scarcity of transformers and other equipment prevents launching of the program on a major scale for the present.

With this program of distribution system improvements in progress, the generation and transmission of adequate supplies of power at reasonable rates becomes a problem for every agency, public and private, which is concerned in the production of the nation's rural power supply. Generating and transmission facilities are already insufficient in many sections of the country, and the need is becoming more acute with each passing month.

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* *Head Generating and Transmission Section Rural Electrification Administration.*

For improvement in the nation's over-all power supply picture, REA and the co-ops are heavily dependent on private power companies and publicly-owned power suppliers, which together furnish at wholesale about 90 per cent of the energy distributed over REA-financed lines. In certain areas where circumstances warrant, REA can help directly by making loans for the installation and construction of generating and transmission facilities. The extent to which this can be done is limited by the necessity of reserving most of each year's loan fund for the construction of distribution lines in unserved rural areas.

Because REA has never had sufficient loan funds available to satisfy the demands of its borrowers, every application for a generating and transmission loan has had to be subjected to the most careful scrutiny. It has always been REA policy to make such loans only in cases where it was impossible for distribution systems to obtain adequate supplies of power or where wholesale rates offered by existing suppliers were so high as to restrict rural electrification development. That policy is not specifically spelled out in the Rural Electrification Act, but it has been adhered to strictly by every REA Administrator since 1935.

Although generating and transmission loans constitute barely 10 per cent of the total volume of REA loans made since the start of the program, loans of this type have been of vital importance in providing farmers in certain areas with adequate supplies of power and in protecting cooperatives from exhorbitant wholesale rates. A recent REA study shows that cooperatives in 13 states have realized savings of $2,265,000 a year in wholesale power costs as a result of the construction of generation-transmission facilities or proposals to build such systems.

That REA regards generation-transmission loans as an essential feature of the rural electrification program was made clear recently by Administrator Wickard when he said: "If rural people lose this opportunity (to obtain generation-transmission loans from REA), they will lose their most potent defense weapon against inadequate service and exhorbitant rates—a defense weapon against those who in the past have always charged for electricity all that the traffic will bear."

During fiscal 1946, the 62 REA-financed systems generating power produced slightly over 283,000,000 kwh. of energy, which they sold at cost to distribution co-ops. This is slightly more than 10 per cent of the amount of power which the distribution co-ops purchased from private companies and publicly-owned suppliers during the same period.

In all, REA has made loans totalling $83,000,000 to finance generating plants and transmission facilities. For the most part these loans have been made to cooperatives formed by distribution co-ops specifically for the operation of generating and transmission systems. A few small loans have been made to distribution co-ops for construction and operation of their own generating plants, and a few have been made to other utilities for construction of facilities serving REA distribution co-ops.

Total capacity of REA-financed generating facilities, as of the end of the 1946 fiscal year, amounted to 105,406 kilowatts, most of it represented by plants with Diesel-driven generators. Capacity was divided as follows: Diesel, 64,452 kilowatts; portable and mobile Diesels, 3,380; natural gas, 3,247; dual fuel, 640; hydro, 17,312; and steam, 16,375.

Largest REA-financed generating and transmission system is that of the Dairyland Power Cooperative of LaCrosse, Wisconsin. This system which serves 22 distribution co-ops in Wisconsin, Iowa, and Minnesota has a total capacity of more than 19,000 kw., of which 14,000 is steam-generated and 4,200 is Diesel. A new Diesel plant of two 2,000 kw. units is just now being put into operation in Wisconsin.

Among other large REA-financed Diesel installations are a 3,600 kw. plant operated by the Federated Cooperative Power Association of Hampton, Iowa; a 4,000 kw. plant operated by the Central Electric Federated Cooperative Association of Pocahontas, Iowa; plants of 2,600 and 1,900 kw. operated by the Tri-County Electric Cooperative of Portland, Michigan; a 2,100 kw. plant operated by the Thumb Electric Cooperative of Ubly, Michigan; a 2,375 kw. plant operated by the Fruit Belt Electric Cooperative of Cassopolis, Michigan; a 3,750 kw. plant operated by the Rural Cooperative Power Association of Maple Lake, Minnesota; and a 5,160 kw. plant operated by the Minnkota Power Cooperative of Grand Forks, North Dakota.

In addition to these large fixed installations, more than 35 portable and mobile Diesel units of 100 kw. capacity are in use by REA-financed cooperatives throughout the country to meet emergency needs.

Among the progressive generating practices which REA encourages co-ops to follow is the installation of either dual fuel or convertible fuel engines in areas where natural gas is available or seems likely to become available. REA also recommends the use of supercharging on new 4-cycle installations.

Considerable expansion in REA-financed generating and transmission facilities is in prospect. The 50 internal combustion units now under construction or contemplated will have a total capacity of 86,000 kilowatts, virtually all of which is represented by Diesel equipment. Completion of these projects, together with the several steam and hydro plants under consideration or in progress, will boost the total capacity of REA-financed generating plants to nearly 200,000 kilowatts.

Provision of adequate power at reasonable rates to meet the expanding needs of American farmers is a challenge to REA, to its borrowers and to the power industry. Only if that challenge is met will American agriculture realize its full potentialities. As Administrator Wickard recently said, "The time has come for 'advanced thinking' about the use of electricity on farms and for 'boldness in planning' to provide adequate service."

IF YOU HAVEN'T ORDERED YOUR COPY OF THE 1946 DIESEL ENGINE CATALOG, VOL. 11, BETTER DO IT TODAY, SEE Page 110.

DIESEL SAWMILL GOES LOGGING

By CHARLES F. A. MANN

FIFTY years ago it was fashionable, in the "big woods" of the Far-West to skin the giants off the hills and valleys with heroic display of hand sawing, falling and bucking, and with great display of sparks, steam and noise, yard them to a railroad spur and haul them miles to some convenient pond or tidewater basin and dump them in. The steam sawmill nearby or perhaps 100 miles by raft further on, did the rest. That was when timber was cheap and plentiful. From tree to 2 x 4's perhaps 50 or 60% of the wood was wasted in one continuous chain from excess waste of smaller trees and giant limbs off of giant trees, to bark lost at the log dump and the innumerable tonnage of thick waste slab and sawdust burned as fuel. But 1946 is a different story. Thousands of fallen trees in the woods that were thought too long-dead and millions of acres of old fire-killed areas or fairly heavy burns, contain billions of feet of good timber for the getting. Values have risen so fast that what was once too worthless for salvaging as firewood is now even too valuable to make rough 2 x 4's. But, it is scattered and its ultimate usage will be finished lumber of smaller lengths, and much does not lend itself to running economically through big mills geared for the 4-6 and 8 ft. high speed bandsaw operation.

So, the question is whether it is cheaper to build mills right up in the big woods and salvage this gigantic wasted harvest ready to be used, or to rebuild the big mills down on Tidewater.

Wasting no time deciding which way to go, the Crooks Brothers of Portland, Oregon, operating as the P. L. Crooks & Co., have effected a neat compromise with both extremes, and have trotted out their neatly engineered portable Diesel sawmill, all mounted on an elongated flat truck wih 238½ inch wheelbase so that it can have its outrigging folded neatly toward the body and hauled anywhere a tractor will go—even up U. S. forest roads with 25% grades!

The Crooks-Johnson portable sawmill is a logger and sawmiller's dream. The object being to be able to set up and run for a few days at a time cleaning up old forest areas with sound, but perhaps short-length timber, then move on, with a fleet of logging trucks and lumber carrying trucks, portable bunkhouses and perhaps a tanker truck for fuel, to a new location.

Billions of feet of "quick" lumber will be added to the nation's supply, for their little mill can turn out from 14 to 15 thousand board feet

Portable Diesel sawmill goes into action. A 16-ft. log has just been lugged into position by the Crain hoist at right. Note screw jackets used to steady the rig. Tender's platform is seen at left. When not in use platform slides into frame.

per day; handle a log 16 or 17 feet long and up to 36 inches in diameter. The compact Diesel drive eliminates sparks and fire danger, the donkey boiler and water problem, and the small side-chain conveyor takes waste sawdust away from the big 60 inch saw and piles it—likewise ready to produce more revenue as sawdust for home fuel burners in the city. In fact the sale of sawdust for residence burners will probably more than pay for the Diesel fuel and lube consumed.

Right now at Forks, Washington, in the far northwest corner of the U. S. A., where it rains 150 inches per year, the first big test of the Crooks-Johnson portable sawmill is being run night and day . . . working over land, logged off 20 years ago and producing a supply of smaller sizes and medium grades of lumber for a distraught seller's market.

Principal features of the mill include, beside the 60 inch saw and capacity of a 36 inch x 17 ft. size log, a main drive with 3 to 1 reduction and full complement of table, niggers, log conveyor, chain driven live rolls, etc. Power for the unit is supplied by a Buda, 4 cycle, 6 cylinder, solid injection Diesel with 5¼ x 6½ in. bore and stroke and displacement of 844.2 cubic inches. At full speed it develops 165 hp. Weight of the complete sawmill and Diesel drive is 23,250 lbs. and it is fitted with 11 screw type jacks to work under the perimeter of the frame to lift the live sawmill load off the springs and rubber tires and stabilize the machine for the rough cycles and jars of the logs being hoisted aboard and rolled and turned on the carriage to get the proper facing against the path of the big saw.

Tomorrow's forestry is an assured fact—tree farms forever growing and harvesting trees as a continuous crop like corn and wheat. Tomorrow's sawmill practices are here today with portable, fireproof, powerful, fast woods-sawmills, that save every speck of the green log, including the valuable bark. Tomorrow's green lumber will be assembled at big re-manufacturing plants in large cities where it will be kiln dried, planed, graded and refined into merchantable quantities to fill orders for the lumber trade.

And the Diesel "Dood It"—as usual!

SPECIFICATIONS

Crooks-Johnson Portable Sawmill

CAPACITY

14,000-15,000 FBM per day
Maximum length log—16'-17'
Maximum diameter log—36"

DIMENSIONS

Length set for sawing—420"
Length ready for travel—324"
Width ready for travel—102"
Carriage length—10'
Distance between knee blocks—7'3"

RUNNING GEAR

Rear Axle Track—72"
Rear Axle Make—Timken 13000# dual tires
Front Axle Track—26½" with single tires
Brakes rear axle only—Air or vacuum optional
Tires—Six 8:25x20 10-ply
Wheels—6-hole Budd
Wheelbase—238½"
Turning Radius—238½"

DRIVES

Main Drive—Direct Right Angle 3:1 reduction with flex couplings
Feed—Friction
Turners—Friction to two cable controlled niggers
Log Conveyor—Friction to reduction drive
Sawdust Conveyor—Chain driven
Live Rolls—Chain driven
Set Works—Hand operated
Log Dogs—Hand operated

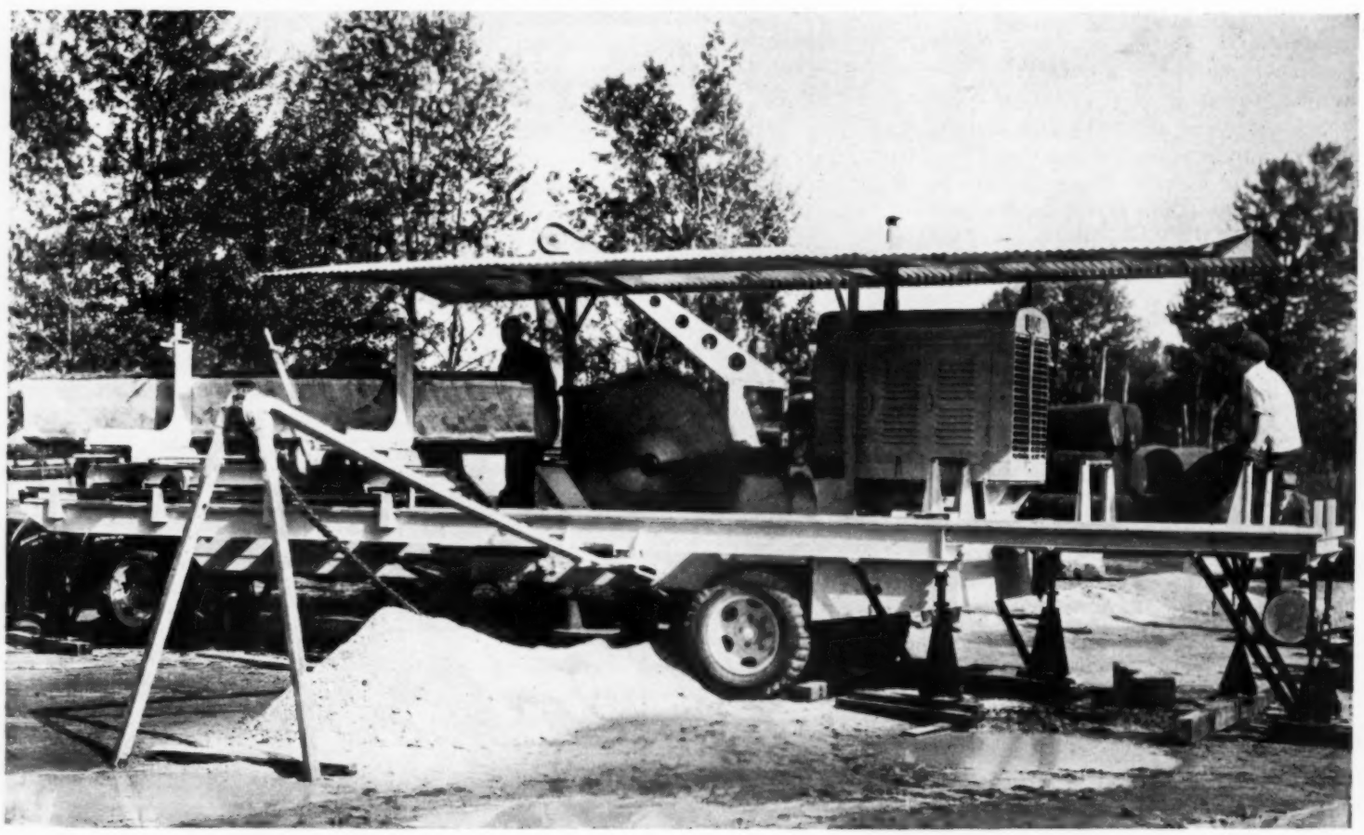
ENGINE

Buda Diesel Model 6-DC-844, 4 cycle, 6 cyl. Solid injection. Bore 5¼". Stroke 6½". Disp. 844.2 cu. in. 165 B.H.P. Twin Disc Clutch.

MISCELLANEOUS

Weight—23,250 lbs.
Saw—60" 43-tooth inserted type
Arbor Shaft—2¼"
Fuel Capacity—250 gals.
Stabilizers—11 screw type platform jacks

Here the 60-inch Buda Diesel-driven saw prepares for its cut. At left can be seen the log-carrying carriage. At right is the 165 hp. Buda Diesel. The A-frame extension in the foreground carries the sawdust conveyer which prevents sawdust from piling under the blade.



STANDARD PRACTICES FOR DIESEL ENGINES

CHAPTER TWO

Editor's Note: The following article is a reprint of the second chapter of the newly revised book "Standard Practices for Low and Medium Speed Stationary Diesel Engines" which was recently published by the Diesel Engine Manufacturers Association. Other chapters of the book will be reprinted in succeeding issues of DIESEL PROGRESS. In answer to a growing demand for the revision of the 1935 edition, this book was published. It includes the refinements, new developments and changing procedures that have marked the advances of Diesel engineering in the past ten years. The aim of this book is to be of service to Diesel engine users, prospective buyers and consulting engineers. It covers stationary Diesel engines operating at speeds up to and including 750 rpm. The book is available to readers of DIESEL PROGRESS *at the price of $2.50 plus mailing charges. Order your copy today from* DIESEL PROGRESS *2 West 45th St., New York 19, N. Y.*

Standard Performances and Equipment

STANDARD Sea Level Ratings.—The possibilities open to the designer of the combustion space and the fuel injection system are so many that no rigid limit can be set for the brake mean effective pressure rating (pounds per square inch) for either two- or four-cycle Diesel engines. To attempt to set such limits would only hamper progress. The standard sea level rating of a Diesel engine is the net brake horsepower the engine will deliver continuously when in good operating condition and located at an altitude of not over 1500 ft. above sea level, with atmospheric temperature not over 90 F. and barometric pressure not less than 28.25 in. of mercury. The standard rating must be such that the engine will deliver an output of 10 per cent in excess of the rating for two out of any 24 hours with safe operating temperatures.

The net brake horsepower referred to is the horsepower delivered to the engine crankshaft coupling, less any power consumed by certain auxiliaries if used and separately driven, namely: injection-air compressor (for air injection type engines), scavenging air pump or blower (for two-cycle engines), supercharging air pump or blower (for supercharged engines), and pumps for circulating lubricating oil or piston coolant through the engine and the cooler. No deductions should be made for the power to drive such auxiliaries if they are mechanically driven by the engine. No deductions are made for auxiliaries intermittently operated or governed in size or operation by special conditions of plant apart from the engine, such as: oil-transfer pumps, circulating water pumps, raw-water pumps, centrifuges, and compressors for starting air. In this connection the reader is referred to the Field Test Code presented in Chapter Sixteen of this book.

Ratings at Higher Altitudes.—Standard sea level ratings with the standard overload margin apply for all altitudes up to 1500 ft. above sea level, with atmospheric temperatures of not more than 90 F. and barometric pressure of not less than 28.25 in. of mercury. This is a purely practical provision to make it unnecessary to correct engine ratings for the average installation. The power which any Diesel engine is capable of delivering decreases as the altitude increases. The lower atmospheric pressure and density at higher altitudes causes this decrease in engine capacity because of the resultant lower quantity of oxygen available for combustion in the engine cylinder. It is therefore the standard practice to base the net brake horsepower ratings at altitudes on barometric pressures not less than those shown on the DEMA standard curve of barometric pressures (Fig. 2) and on a standard maximum temperature of 90 F.

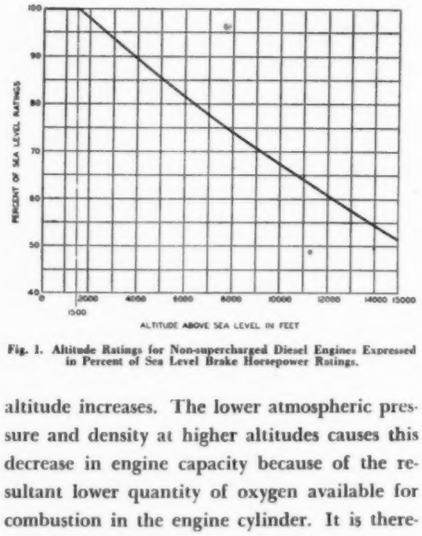


Fig. 1. Altitude Ratings for Non-supercharged Diesel Engines Expressed in Percent of Sea Level Brake Horsepower Ratings.

The net brake horsepower ratings of normal non-supercharged Diesel engines at various altitudes, expressed in per cent of the sea level rating, are shown in curve form in Fig. 1.

Reduction in rating due to increase in altitude for supercharged engines is basically the same as for non-supercharged engines. However, the engine builders are using various means of supercharging, and proper allowance must be made for any additional power required by the superchargers and any other factors affecting engine capacity in order to maintain the usual margin of overload capacity at the altitude without exceeding safe operating conditions.

Brake Horsepower Capacity and Fuel Consumption Guarantees.—The standard practice in respect to guarantees of brake horsepower capacity and fuel consumption is to base these upon tests conducted by the engine builder on his shop test floor. Such tests are conducted on original models of a production series and shop tests of subsequent engines are optional with the manufacturer. Test set-ups for the larger Diesel engines which are usually dismantled for shipment are cumbersome and expensive; therefore, they are often tested in the field after installation rather than shop tested.

Brake horsepower capacity guarantees for Diesel engines operating at 0 to 1500 ft. altitude are made contingent upon an air intake pressure of not less than 28.25 in. of mercury and air intake temperature of not more than 90° F.

Fuel oil consumption guarantees are made in pounds per net brake horsepower hour at one-half, three-quarter and full load (sea level rating or altitude rating) when operating at rated revolutions per minute. Gas-burning and dual-fuel Diesel engine gas consumption guarantees are made in Btu. per net brake horsepower hour and are based on low heat value. Fuel oil and pilot oil guarantees are based on a high

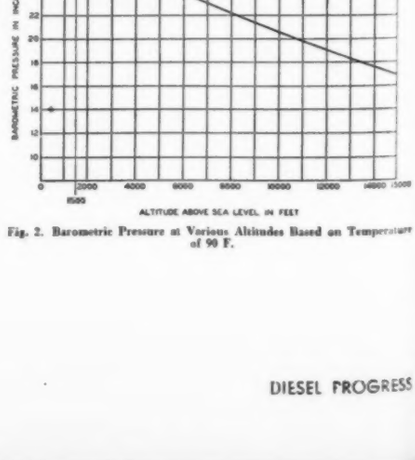


Fig. 2. Barometric Pressure at Various Altitudes Based on Temperature of 90 F.

(gross) heat value of 19,350 Btu. per pound. All sea level fuel consumption guarantees are contingent upon the following conditions:

1. Intake air temperature between 40° F. and 90° F., inclusive.
2. Barometric pressure of intake air between 28.25 in. and 30 in. of mercury, inclusive.
3. Fuel to conform to the engine builder's specifications as set forth in his bid or tender.

In adopting these standard practices, the engine builder absorbs the differences in performance caused by three variables. The intake air density may vary 4.8 per cent from the mean due to temperature; it may vary 2.9 per cent from the mean due to pressure; the low (effective) heat value of the fuel may vary as much as 300 Btu. (1.6 per cent) for the same high heat value.

This last variable deserves a word of explanation. All heat engines utilize only the low heat of whatever fuel is used; the margin of heat between this value and the high heat value is not fully available to the engine. Due to the greater ease and accuracy with which the high heat value of fuel oil can be determined and checked, however, domestic oil refiners and distributors sell oil on the high heat basis exclusively. It is for this reason that members of this Association base fuel oil consumption guarantees on that value.

These variables are independent of each other and, in any specific case, may accumulate adversely. To safeguard the engine builder in allowing these wide latitudes in conditions, all fuel consumption guarantees should be subject to a tolerance of 3 per cent and a correction for any deficiency in the thermal value of the fuel.

Standard fuel consumption guarantees are not made for one-quarter load. There are several good technical reasons for this. Small differences in cooling water temperature or in internal friction have a disproportionate effect at such low load, especially in the case of a new engine. Therefore tests for quarter-load fuel consumption are inaccurate and not reproducible. Generator builders do not make quarter-load efficency guarantees so the results cannot be expressed in terms of fuel per kilowatt hour.

Field Tests for Horsepower Capacity and Fuel Consumption.—If the buyer of a Diesel engine so requests, a guarantee test for horsepower capacity and fuel consumption will be made after the engine is installed in its ultimate location. When more elaborate tests are required by the buyer, it is recommended that such tests be conducted in accordance with the Field Test Code presented in Chapter Sixteen of this book. Such tests are costly. Obviously the whole cost of such testing must come from the whole body of buyers of Diesel engines. It is, therefore, equitable that each buyer requesting any field test be required to bear the fair and full cost of it, including the furnishing of (a) all apparatus required; (b) all labor necessary for the installation and operation of such apparatus, for the observation and recording of test data, and for the calculation of test results; and (c) all fuel, lubricating oil, water, supplies and the appropriate steady loads required for the tests requested. Such fuel and lubricating oils furnished shall be in conformity with the engine builder's specifications for the type and speed of the engine to be tested.

Lubricating Oil Consumption. — The same Diesel engine if installed in several plants in succession, would show different rates of lubricating oil consumption, so material is the influence of plant conditions and operation on lubrication requirements. It is quite out of the question for the engine builder to control such conditions and operation. It is, therefore, neither feasible nor logical for a responsible builder to guarantee the lubricating oil consumption of his engines. The user should consult the engine builder for recommendations on suitable lubricating oil.

Standard Equipment for Stationary Engines.—The minimum amount of equipment which should be standard for a stationary engine should not include any apparatus which might require different treatment for different installations. With this precept in mind, the following list is offered as a standard of minimum equipment. Whenever the items listed are required by the design of any engine, they should be furnished with it, but items not so required should not be furnished. For instance, it would be superfluous to include piston-cooling equipment with an engine having dry pistons.

Standard Equipment and Service Stationary Engines

Engine flywheel (except in the case of flywheel type generator).
Extension shaft and outboard bearing if required.
Piping on engine to inlet and outlet connections.
Exhaust manifold or its equivalent.
Air inlet manifold or its equivalent.
Blower and its driving equipment for engines which are supercharged.
Scavenging air equipment for two-cycle engines.
Lubricating oil strainer or its equivalent.
Fuel oil strainer or its equivalent.
Fuel oil booster pump if required.
Lubricating oil sump tank if required.
Force-feed lubricator if required.
Lubricating oil pumps and coolers if required.
Piston cooling oil pump and cooler if required.
Pump for circulating lubricating oil before starting and after stopping oil-cooled-piston engine if required.
Lubricating oil pressure gauges for pressure system.
Engine cooling water pressure gauges if required.
Thermometers for lubricating oil to and from engine, and piston cooling oil if required.
Thermometers for engine cooling water supply and discharge.
Compression release valves and safety valves if required.
Suitable governing equipment.
Synchronizing device, hand or electrically operated (for generator units) where necessary.
Flywheel barring device, hand or power operated.
A set of special tools for each installation (not duplicated for more than one engine per engine room).
The builder's standard set of spare parts.
Engine platforms and steps or stairs if required, but not including interconnecting platforms.
Drilled and tapped holes for exhaust temperature measuring devices, but not including such devices.
Drilled and tapped holes for attachment of an indicator, but not including the indicator, indicator valves, or reducing motion.
Foundation bolts, nuts, and anchor plates, including those for generator and exciter, and for main and auxiliary engine equipment if these units are furnished, but not including sleeves or casings.
Instruction book for operator.
Foundation blueprints for good soil.
Profile prints showing size and location of piping on engine, to which buyer connects.
Diagrammatic prints showing recommended arrangement of typical station piping.
Engine part lists.

Standard Governor Performance.—As its name implies, the function of a governor is to govern, or regulate, the speed of an engine under varying load conditions. The need for such regulation varies with the driven equipment and load conditions. For industrial electric drives involving a single generator where constant voltage is not important, for non-electric drives, and where loading is relatively uniform there

is usually little need for governor regulation closer than 5 to 6 per cent (variation between full load and no load speed in percentage of full load speed). For multiple electric drives such as municipal plants where time clocks and other constant frequency equipment is involved, much closer regulation is required.

Two types of governors are commonly furnished with Diesel engines: (1) non-isochronous, or (2) isochronous, depending on the service intended. Non-isochronous may be either centrifugally-powered or relay-powered.

The following shall be the standards recognized for the centrifugal type:

1. The governor will control the engine speed to 5 to 10 per cent of the rated speed upon gradual load chages from no load to full load, or vice versa.
2. For sudden changes in load within the limits of engine rating and not exceeding one-half rated load, the momentary speed change shall not exceed the normal no load-full load percentage regulation. This momentary speed change shall be in per cent of speed at instant of load change.
3. Under constant load there shall be no hunting; with changing load there shall be no sustained oscillations of speed or power output following a load change.

The standards recognized for non-isochronous governors of the relay type should be the same as outlined above, except that the governor will control the engine speed to 2 to 8 per cent upon gradual load changes.

The following should be the standards of governors of the isochronous relay powered type, with adjustable speed droop[1]:

1. The governor will control the engine speed from 0 to 3 per cent of the rated full load speed upon gradual load changes from no load to full load, or vice versa, the percentage of regulation to be adjustable during engine operation.
2. Where engines are intended for parallel operation, the momentary speed change for sudden changes in load within the limits of engine rating and not exceeding one-half rated load, shall not exceed 5 per cent of the speed at instant of load change.
3. Under constant load there shall be no hunting; with changing load there shall be no sustained oscillations of speed or power output following a load change.

[1] *Isochronous governors without speed droop adjustment may be furnished where such characteristics are suitable.*

A further discussion of governing will be found in Chapter Four.

Standard of Parallel Operation.—Engine builders will usually be able to furnish units which will operate in parallel with existing installations. This, however, cannot be guaranteed without complete information on the existing units.

Failure to parallel successfully cannot be proved by the behavior of switchboard instruments which are not properly damped.

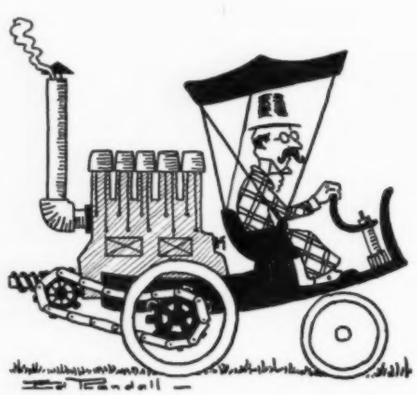
A further discussion of parallel operation will be found in Chapter Four.

Warranty.—It is recommended that wherever practical the Standard Warranty of the engine manufacturer be used. In cases where such a warranty is not available, the following form is offered as a suggestion:

Guaranty of Workmanship and Materials

"The company guarantees that the machinery manufactured by it which it proposes to furnish hereunder will be well made, of good material and in a workmanlike manner, and that if, within one year from the date of shipment thereof, any guaranteed part should fail because of defective material or workmanship in the manufacture thereof and specific written notice of such failure be given the company within such time, the company shall replace such defective part, free of charge, f.o.b. cars its factory; provided, that, at the option of the company, parts claimed to be defective shall be returned to the company's factory for inspection, with all transportation charges thereon prepaid by the purchaser.

"All guaranties and warranties with respect to machinery, apparatus, accessories, materials, or supplies not manufactured by the company shall be limited to the respective guaranties or warranties of the manufacturers thereof. The company shall not be liable for any repairs or alterations except those made with its specific written consent and approval and shall not be liable for damages or delays, whether caused by defective material or workmanship or otherwise; and it is expressly agreed that all liability of the company with respect to said machinery, or its use or operation, including that under any and all guaranties or warranties, whether express or implied, is strictly limited to the replacement, in the manner aforesaid, of guaranteed parts failing, within the time hereinbefore stated, by reason of defective material or workmanship in the manufacture thereof."



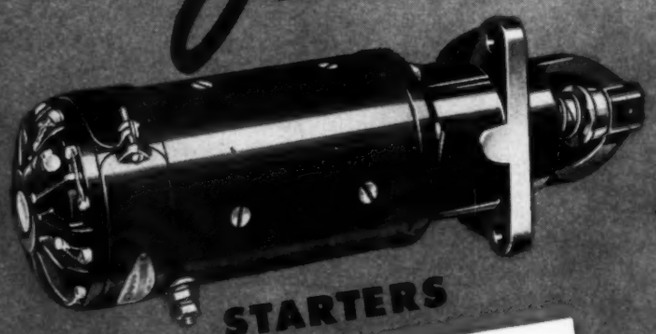
Torsional Vibration and Critical Speeds.—In the case of constant speed units, it is the standard practice to so coordinate the assembly of each engine and the driven equipment that there shall be no harmful torsional vibrations within 10 per cent above or below the normal operating speed of the unit. When the engine and all the driven equipment is furnished by the engine builder, this entire responsibility rests with him. When the driven equipment is furnished by anyone other than the engine builder it is the buyer's responsibility to furnish to the engine builder, at no expense to the latter, such information as is necessary in order for the engine builder to properly make this coordination. If this information is not given completely and definitely in the invitation to bid, the engine builder shall not bear the expense of, or be responsible for, delays caused by changes necessary after his bid has been submitted on this account.

In the case of variable speed units, it is the standard practice to so coordinate the engine and driven equipment that the operating range is as free from vibrational stresses as possible and to advise the buyer of any speeds at which the vibrational stresses exceed the safe operating limit, and operation at these speeds must be avoided.

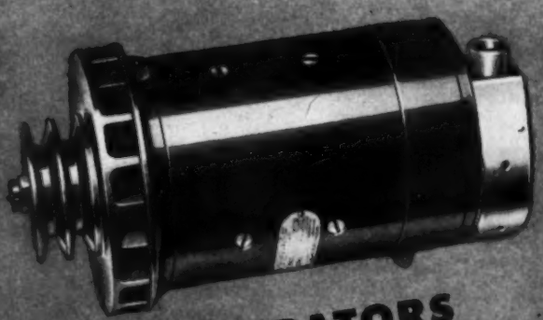
Torsional vibration damping devices are not usually furnished as standard equipment. They may be supplied as extra equipment when required by special conditions.

Standard Finish.—Engines shall be given at least one coat of primer or filler, and finished with at least one coat of paint of the manufacturer's standard color. Special colors and finishes will be furnished upon request, at extra cost.

Switch to AUTO-LITE for Diesels



STARTERS



GENERATORS

AUTO-LITE electrical systems for Diesels are the result of Auto-Lite's 35 years of automotive electrical experience. Auto-Lite engineers were among the first to start internal combustion engines electrically. Auto-Lite Diesel systems are complete from generator to voltage control to battery to starter. Engineers and executives are invited to consult with us on Diesel cranking and generating equipment.

THE ELECTRIC AUTO-LITE COMPANY
TOLEDO 1, OHIO
SARNIA, ONTARIO

BATTERIES

TUNE IN THE AUTO-LITE RADIO SHOW STARRING DICK HAYMES—EVERY THURSDAY NIGHT, 9:00 P. M.—E. T. ON CBS

SUPERVISING & OPERATING ENGINEERS' SECTION

Conducted by R. L. GREGORY*

"TROUBLE SHOOTING" PART 8

CONTINUING our discussion of the air compressor and its component parts, let us next take up the air cooling system and the main troubles one may run into with this part of the air system. The most conventional type of cooling system on this type of air compressor, the three stage type, consists of a cooling shell and a cover plate through which the cooling agent is forced and which is common to all three stages of cooling.

The cover plate, however, is divided into three sections, one for the passage of the low pressure air, one for the passage of the intermediate stage air and the third for the high pressure stage air. These three sections are separated from each other in such a manner that the air passing from one stage to another is cooled before it enters the following stage.

Each stage is equipped with a set of either copper coils or in some instances copper tubes through which the air flows, the cooling agent flowing around the outside of these coils or tubes. As stated in a previous issue, the normal operating pressure of the low pressure air is from 40 to 50 pounds, that of the intermediate stage being from 220 to 250 pounds and the high pressure air being from 600 to 1200 pounds, the pressure being determined by load and operating conditions.

Now it is obvious that this air passes through these cooling coils at high velocity, and consequently will have wearing effect on the inside of the coil. This wearing or corrosive effect will naturally be greater in the coils handling the higher pressures of air. Consequently good maintenance demands that these coils be inspected at regular intervals and tested under hydrostatic pressures at double the pressure of operating conditions.

Generally the coils found in the low pressure stage, where the pressure is normally below 50 psi. will give but little trouble, but those in the intermeidate and especially the high pressure stage should be carefully watched. Most of these types of coolers have these coils fastened to the cover plate by means of a cinch ring drawn into place by a cinch nut, with the end of the coil flared to fit into a funnel shaped throat on the cover plate.

One of the best methods to check these coils for leaks is to remove the cover plate with the coils attached, block off the discharge end of the particular stage being tested by means of a blank steel flange, and then fit up the intake side of that stage with fittings to apply air pressure, these fittings to be so arranged that a gauge can be installed in the line. The coils are then filled with water and after that air pressure can be applied to the section being tested by means of a hydrostatic pump.

For example let us say that we are testing the high pressure stage coils. The discharge end has been sealed with a blank flange and gasket, the coils filled, and the pump attached to the intake side of the coils. Hydrostatic pressure is then applied until the gauge shows double normal operating pressure, say 2000 psi. If the gauge shows that the pressure is being maintained with no loss or drop of pressure for a ten minute period, if it safe to assume that there is no leak in these coils. However if it appears from the gauge reading, that there is a loss, then a coating of soapy water should be applied to the coils and especially around the cinch nut. If there is an air leakage at this point, bubbles will form and the leak can easily be detected at that point.

However it is a good practice to change the high pressure air cooling coils at least once a year. From external appearances it is almost impossible to detect the amount of corrosion and wear on the inside of these coils. Consequently they may become so worn and corroded, that the walls become thin and the erupting of a coil within the cooling shell might be very disastrous, so much so that a sudden eruption on one of these coils with the resultant sudden release of air into the cooling shell would break the shell. This condition has been known to happen causing an outage of several days, before repairs can be made.

Most of these types of shells have a protective device consisting of a special copper erupting disc, which when a coil in the cooler bursts, will protect the cooler shell from breaking, as this disc will also erupt and relieve the air pressure.

The high pressure cooling coils which are removed do not have to be discarded. They can be moved down to one of the lower stages and in these stages will function for many months. About the only method of detecting a badly worn coil is by weighing it. If there is considerable discrepancy between the weight of a coil which has been used for a long period and the weight of a new coil one can almost be assured that the copper wall is worn thin.

One other point should again be called to the reader's attention, while on the subject of these coils. That point is the corrosion and rust which forms in the funnel shaped throat at the point of contact between the copper coil and the cover plate. In one of the previous issues of DIESEL PROGRESS, this matter was taken up under the "Maintenance Section" and it was suggested in this article that, a reamer of the proper angle be secured for clearing up the surface of the throat at this point, in order to remove rust and pitting, so that a tight joint can be maintained between the cover plate and the cooling coil.

Now in presenting these articles on trouble shooting, the writer has merely touched some of the high points of this type of engine maintenance. There are many others which will arise in one's daily work, and these problems of trouble shooting vary with the conditions in each plant, and on different types of units, and it is not the intention of these article to cover all the points of trouble shooting, but rather to cover those which most frequently occur. If our readers have other points which they would like to discuss on this subject of "Trouble Shooting," we will welcome any ideas on the subject, since that is what this section is for, to get your ideas and opinions. However, one thing can be said, and that is the old adage, "That a good trouble shooter is one who never has to shoot trouble, since in doing his work he is always a jump ahead of trouble, and has his units in such shape, that these difficulties are detected and corrected before they reach the stage of real trouble."

* *Chief Engineer, Municipal Water and Light Plant, Hillsdale, Michigan.*

TURBINE LUBRICATION

Turbine Oil gives 34 SERVICE HOURS per Gallon over 6 YEAR PERIOD

Extent of conditioning has been to run oil through centrifuge at only 3 intervals during entire time

Lubrication Engineer's Report

"The service record of the 25,000 KW Unit in The Empire District Electric Company's Steam Turbine plant located at Riverton, Kansas, covers a six year period — beginning April, 1939.

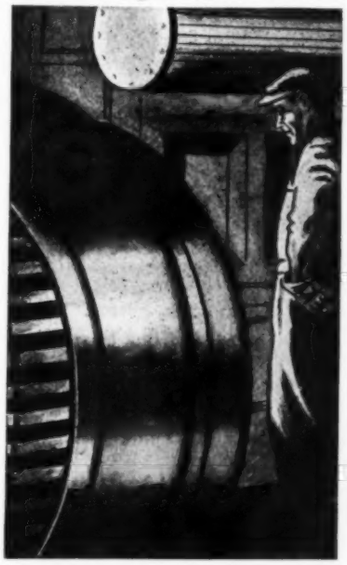
"During this time the *same* oil has been in use and 'make-up' has totaled 1,431 gallons, or an average of 34 service hours per gallon of make-up. Quantity of oil in the oiling system is 1,100 gallons. Neutralization number on oil at start of this run was .05 mg. KOH; maximum value reached was .320 mg. KOH; the average value was .208 mg. KOH; and present value .250 mg. KOH.

"There has been no draw-off of oil to add "sweetening." The make-up added has been to compensate for losses due to vaporization, leakage and such losses as occur during routine machine inspections.

"The extent of the conditioning this oil received has been to run it through a centrifuge at three intervals in the six years to remove any accumulated moisture resulting from condensation in the reservoir.

Moisture Content Negligible

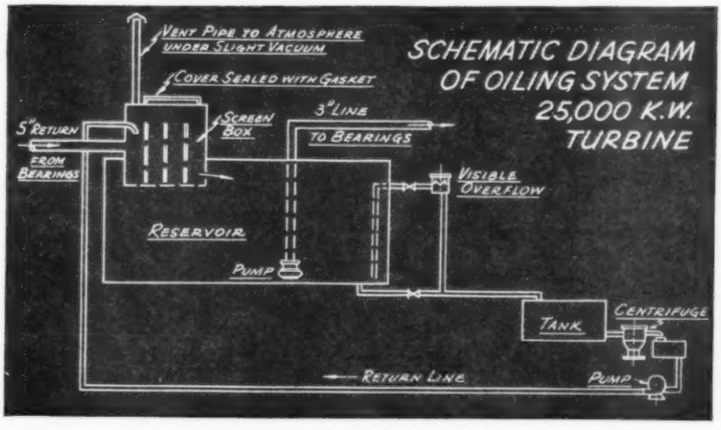
"One of the reasons for the successful performance of the Cities Service turbine oil is the method used to vent the system of vapors. The hot oil return from the bearings to the reservoir, empties into a chamber carrying the screens to remove foreign particles that might damage the oil circulating pumps. A considerable vapor is liberated at this point (oil temperature, 150-160 deg F.), and instead of being permitted to condense is drawn off through a vent line, under a slight vacuum. While there is a tangible loss of oil in the vapor, the moisture content is held practically negligible and is, therefore, of material help in maintaining the oil in good condition.



"The above is typical of the experience with Cities Service turbine oil in each of Empire's five turbo-generator units."

Expert Counsel Available

Cities Service Lubrication Engineers know ways and means for reducing costs and improving the performance of lubricants. For help or information call the branch office nearest you, or write Cities Service Oil Co., 60 Wall Tower, New York 5, N. Y.



SCHEMATIC DIAGRAM OF OILING SYSTEM 25,000 K.W. TURBINE

CITIES SERVICE OILS
ONCE-ALWAYS

FOR EVERY LUBRICATION PROBLEM CALL Cities Service FIRST!

Exchange Your Diesel Maintenance Ideas

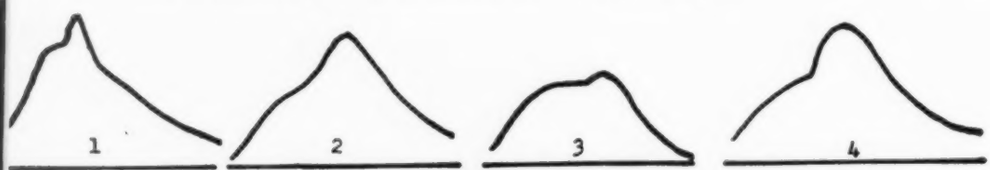
INDICATOR PROBLEMS

Conducted by R. L. GREGORY

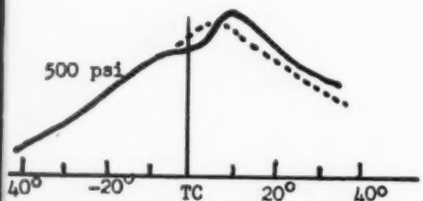
Editor's Note: In this department we provide a meeting place where Diesel and Gas engine operators may exchange mutually helpful maintenance experiences to keep our engines in top condition. Mr. Gregory edits your material and adds constructive suggestions from his own wide experience. This is your department—mail your contributions direct to DIESEL PROGRESS.

THIS month's maintenance section is devoted to a series of problems on indicator diagrams which are intended to follow up the two articles devoted to indicators in recent issues of DIESEL PROGRESS. The problems were submitted by Dr. P. H. Schweitzer of the Pennsylvania State College, author of the previous articles.

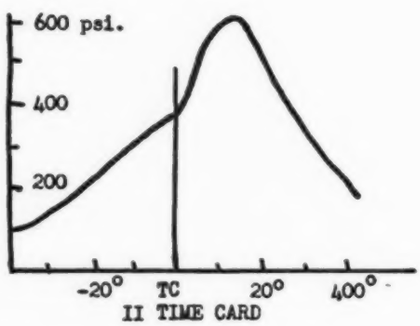
Underscore the more nearly correct answers: Cards I are pull cards from a slow speed solid injection engine.



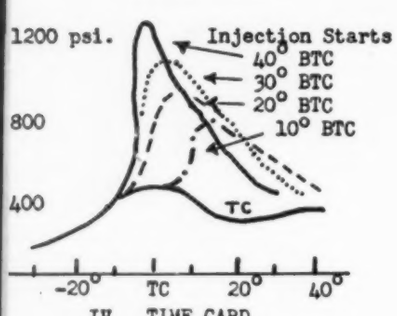
I PULL CARDS



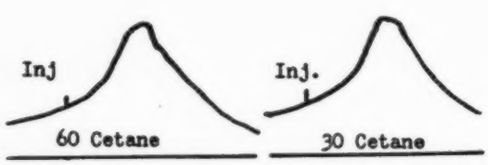
III TIME CARD

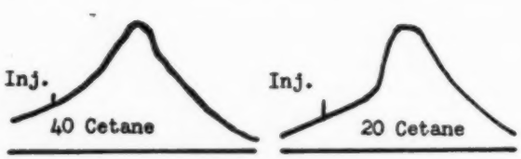


II TIME CARD

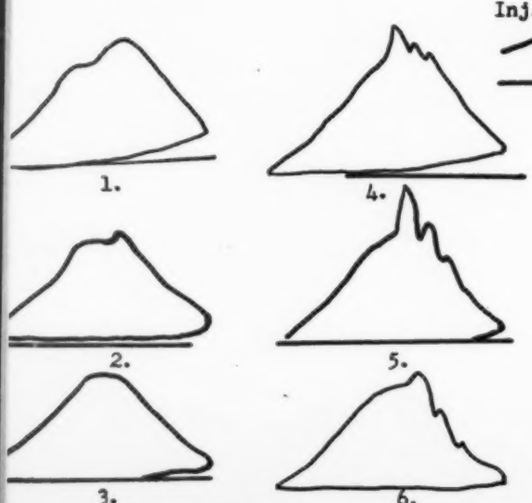


IV TIME CARD

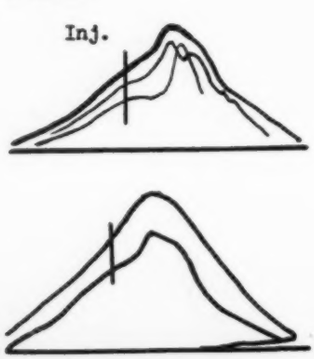




V. CARDS



VI OFFSET CARDS



VII OFFSET CARDS

Card 1 Injection is early, correct, late.
Load is idling, light, full.
Card 2 Injection is early, correct, late.
Load is idling, light, full.
Card 3 Injection is early, correct, late.
Load is idling, light, full.
Card 4 Injection is early, correct, late.
Load is idling, light, full.

Card II Card is from a high speed solid injection engine.
Do you expect the combustion to be smooth, medium, hard?

Card III Engine running under identical operating conditions with two fuels gave cards 1 and 2.
Fuel No. 1 has low, high, ignition quality.
Fuel No. 2 has low, high, ignition quality.

Card IV An engine set to various injection timings gave cards as shown. On the basis of the card which injection timing would you select?
40°BTC 30°BTC 20°BTC 10°BTC TC

Cards V An engine, operated with fuels of varying ignition quality gave cards as those marked. On the basis of the appearance of the card which is the lowest cetane number fuel that you would consider acceptable for the engine?
Cetane No. 60 Cetane No. 40
Cetane No. 30 Cetane No. 20

Cards VI Cards 1, 2, 3, and 4, 5, 6 were taken from an air injection and solid injection engine respectively at different loads.
Card 1, the load was light, medium, heavy.
Card 2, the load was light, medium, heavy.
Card 3, the load was light, medium, heavy.
Card 4, the load was light, medium, heavy.
Card 5, the load was light, medium, heavy.
Card 6, the load was light, medium, heavy.

Cards VII The highest of diagrams 1 and the lowest of diagrams 2 are normal, the rest show
1. Clogged air cleaner, heavy valves, too thick cylinder head gasket, too late timing, insufficent fuel.
2. Too thin cylinder head gasket, low cetane fuel, too early timing, too much fuel, supercharge.

Answers will be found on page 107

UNINTERRUPTED

PAYLOAD PRODUCTION WITH SINCLAIR GASCON OIL

Municipal power plant of Coon Rapids, Iowa, reports completely satisfactory operation with Sinclair Gascon D for its 1000-h. p. Fairbanks Morse Diesel.

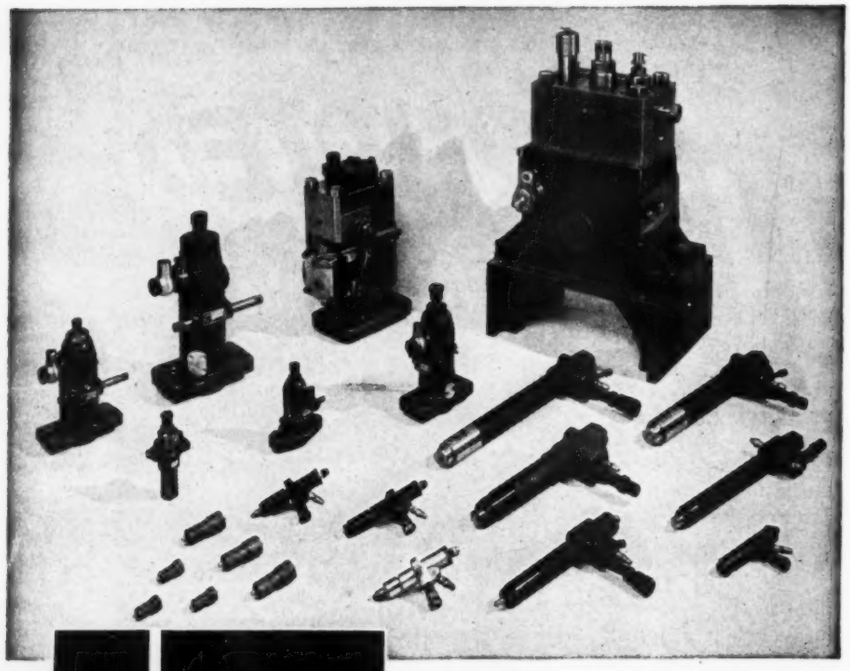
SUSTAINING uninterrupted payload output with Diesel engines calls for careful attention to lubrication. An incorrect oil leads to engine breakdown, overhaul, unproductive shut-down time, high maintenance cost.

Inherent properties give Sinclair GASCON OILS *natural* ability to disperse carbon formation, to discourage crankcase accumulations and ring sticking.

Efficient, high output operation is a proven fact with Sinclair GASCON. Let us advise you how to save money by sustaining uninterrupted payload production with GASCON.

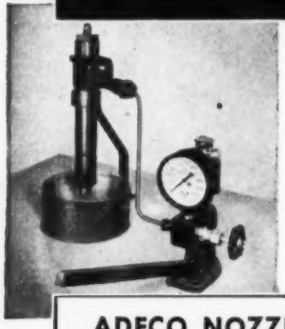
SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.



adeco...

YOUR SOURCE FOR DEPENDABLE FUEL INJECTION EQUIPMENT



Whether you need standard fuel injection equipment or special units built to your specifications, Adeco offers the logical source of supply.

Today's line of Adeco equipment, the outgrowth of long experience in serving the Diesel industry, includes: Standard fuel injection pumps in plunger diameters from 7 mm. to 31 mm.; a complete line of standard nozzles and nozzle holders, including the water-cooled type; and the Adeco nozzle tester.

All Adeco products are built to highest standards, with years of trouble-free operation behind them to testify to their reliability.

ADECO NOZZLE TESTER

For Low-Cost Maintenance

America's most widely used nozzle tester enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Compact, portable, sturdy, precision-built. Pressures up to 10,000 p.s.i. Tests both large and small injectors on bench or engine. Prevents costly delays and possible damage to engine. Standard or Navy-approved gauge. Ideal for testing hydraulic equipment. Write for bulletin.

ADECO

AIRCRAFT & DIESEL EQUIPMENT CORP.

4401 NO. RAVENSWOOD AVE. • CHICAGO 40, ILLINOIS

H. M. Petersen Establishes Consulting Service

H. M. PETERSEN has set himself up as a consulting engineer at 2647 Buchanan Street, San Francisco 15, California. As many of our readers will remember, H. M. Petersen has been connected with big engine installations in this country for a great many years. A graduate of the Polytechnic Institute of Copenhagen, Denmark. He speaks several languages and had a wide technical knowledge of Diesel engine design and construction before he came to this country some 20 years ago. For many years he was connected with the Hooven, Owens, Rentschler Division of the General Machinery Corporation of Hamilton, Ohio, and had a great deal to do with the outstanding installations of Hamilton Diesel engines first at Vernon, California, then at Brawley, California, then at Phoenix, Arizona. In addition to this he has been extremely active in the marine field.

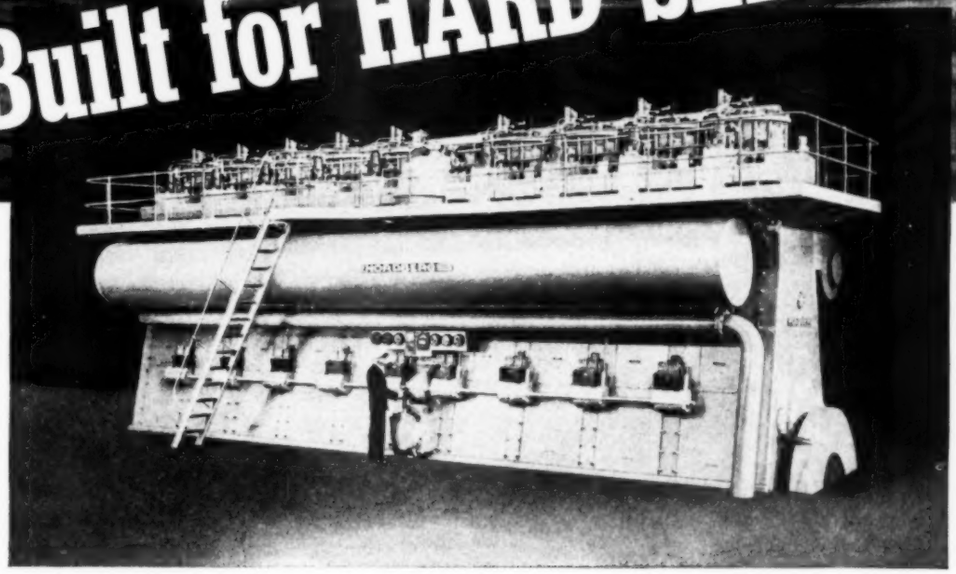
H. M. Petersen

We wish Mr. Petersen every possible success as he takes up the work of a consulting engineer. He is an extremely capable citizen and can be relied on to do an outstanding job for any and all clients who select him.

How DeLaval Centrifugals Are Used on the "E. J. Block"

WE were partially in error in implying, in our article on the converted ore carrier, *E. J. Block*, which appeared in the November issue of DIESEL PROGRESS, that both of the De Laval centrifugals installed on this vessel are used for fuel oil cleaning only. One De Laval centrifugal is used entirely for purifying fuel oil, the other unit is connected so that it may be used for purification of engine lube oil either direct from the engine sumps or from any of the auxiliary tanks as well as for purification of the reduction gear lube oil.

Built for HARD SERVICE



This 6,000 shaft horsepower Nordberg Diesel engine is propelling a Victory type vessel.

Nordberg Marine Diesel engines are built in two and four-cycle types in a wide range of sizes up to 8000 S.H.P. in a single unit. These are available for direct drive for single or twin screw vessels or for single or twin engine, reduction gear drive for single screw vessels.

THE satisfactory performance of the many Nordberg Diesel propelled vessels is ample proof that these engines are built to meet the hard and exacting service as demanded by today's shipping. When thinking about propelling power for that new ship or more economical and dependable power for an existing vessel, investigate the merits of Nordberg Diesel power.

NORDBERG MFG. CO., MILWAUKEE 7, WIS.

NORDBERG MACHINERY

NORDBERG

DIESEL ENGINES

NORDBERG MACHINERY

Southern Pacific Orders 25 Electro-Motive F-3's

SOUTHERN Pacific has ordered twenty-five 6,000 horsepower Diesel-electric mainline locomotives from Electro-Motive Division of General Motors Corp.—twenty recently ordered for freight service, and five ordered earlier for passenger streamliners. Delivery is expected to begin next year on both the freight and passenger types.

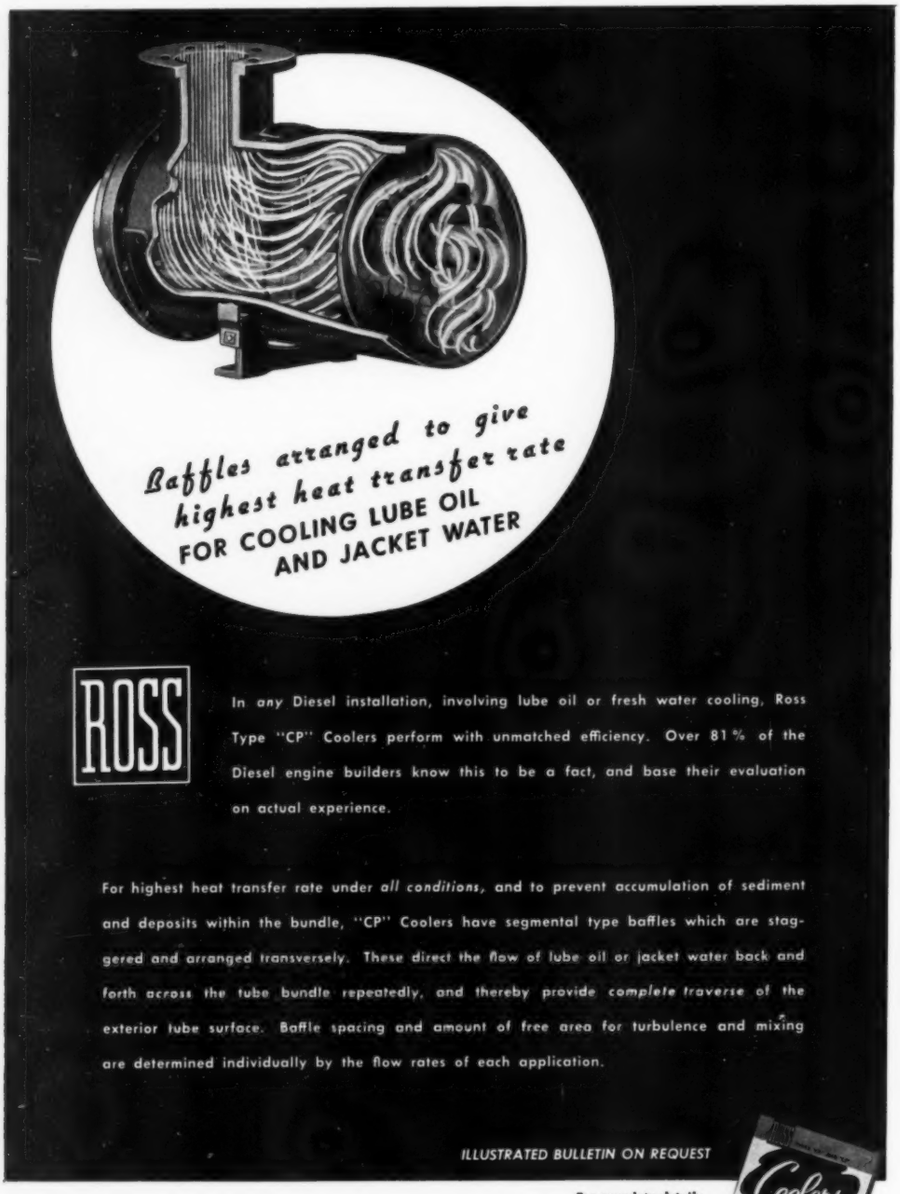
The freight locomotives will be made up of four units each, with a cab on each end so the locomotives can be operated in either direction without being turned. They will be used mostly between Los Angeles and Lordsburg, New Mexico, and are expected to cover about 10,000 miles per month. Special shops for these and the Golden State route passenger Diesels will be built in Los Angeles, and large facilities installed at Tucson. The freight Diesels will have a 62-15 gear ratio, with top speed at 65 miles per hour on level track. All weight will be on the 16 pairs of 40-inch drive wheels, giving the locomotive a starting tractive effort of 230,000 pounds, and a continuous tractive effort of 130,000 pounds at 14½ miles an hour, at which speed maximum pulling efficiency is achieved. The new freight Diesels are expected to find their most important use in pulling the long trains of perishable crops, as they will not have to stop for fueling between Los Angeles and Tucson.

Three of the passenger locomotives, each made up of three 2,000 horsepower units, will be for use on the Golden State route between Los Angeles and Chicago. They will have a 52-25 gear ratio, giving them a top speed of 117 miles per hour on level track. The two other passenger locomotives will power the new "Shasta Daylight" streamliners now being built for operation between San Francisco and Portland. They will have a 55-22 gear ratio, giving a top speed of 98 miles per hour on level track and extra pulling power to maintain schedules over the Cascade grades.

On the new passenger Diesels for the Shasta and Golden State routes an innovation will be the large heating boilers, three to each locomotive, each boiler capable of converting 3,000 pounds of water per hour into steam for heating the trains. Each passenger Diesel locomotive will carry 4,800 gallons of water for its heating system, and 3,600 gallons of fuel. Stops for water will be fewer. On the Golden State route, for example, fueling stops are planned only at Tucson, El Paso, and Tucumcari in Southern Pacific territory, with three additional stops in winter for water. On the Golden State route the passenger Diesels are each scheduled to cover 23,696 miles every four weeks, spending two 45-hour layovers in the Los Angeles shops for maintenance.

Bilgewater For Fuel

WARREN CONWAY of Carnevey, Louisiana, was fishing recently in his Diesel driven boat when the return line from the fuel pump accidentally came loose from the fuel tank. When Conway started back to port, he was out of fuel. Upon investigating the source of trouble, he found his supply was in the bilge. Using a bucket, he transferred what was in the bilge back to the tank and ran into port. The filter was changed and fresh fuel put in his tank. Conway reports no damage to the engine which brought him home on the bilgewater without missing a beat. The Sheppard people don't recommend using bilge water for fuel, but it justified their statement their Diesel will operate on any combustible fluid that can be pumped through the injectors.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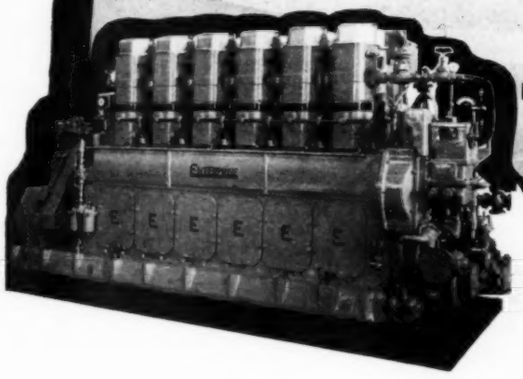

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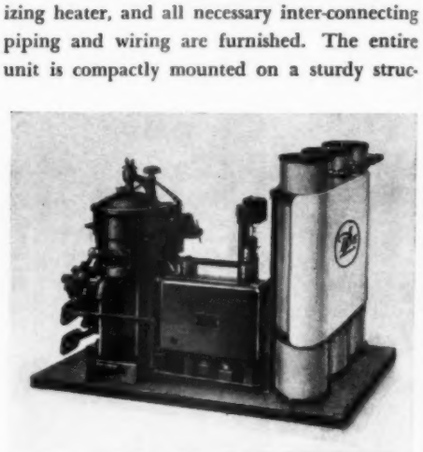
New De Laval "Puri-Filter" Announced

THE De Laval Separator Company at the Power Show will exhibit for the first time the De Laval "Puri-Filter"—a combination of the De Laval "Uni-Matic" Oil Purifier and the Fram "Filcron" Filter.

Although the "Puri-Filter" is now announced for the first time, the operation of the De Laval Purifier with the Fram Filter has been tested at several power plants over the past two years. The manufacturer's claims for the product are based on the records made on these field installations.

The De Laval "Puri-Filter" will enable the Diesel operator to secure the advantages of purifying Diesel lubricating oil by centrifugal force and by positive filtration. Heretofore he has been forced to choose between centrifugal force, which removed most solid impurities and all water, and filtration which in cleaning the oil also restored a good measure of color but which provided no protection against water. With the "Puri-Filter," Diesel lubricating oil can be maintained both clean and dry—the maximum protection for every engine.

The De Laval "Puri-Filter" combines a De Laval "Uni-Matic" continuous centrifugal, complete with dirty-oil and clean-oil pumps, with two or more Fram Micronic Filters. In addition, a thermostatically controlled non-carbonizing heater, and all necessary inter-connecting piping and wiring are furnished. The entire unit is compactly mounted on a sturdy structural steel base. To place the "Puri-Filter" in operation, it is only necessary to make connections to the oil sump and to the power supply. For the first time, the Diesel operator can continuously purify and restore his lubricating oil to "like-new" quality and appearance. The advantages of keeping lubricating oil in good condition by this means are manifold:



The De Laval "Puri-Filter" combining the De Laval "Uni-Matic" Oil Purifier and the Fram "Filcron" Filter.

The "Puri-Filter" removes dirt and water by centrifugal force; it also removes harmful carbon by filtration. The "Puri-Filter" will not, however, remove valuable additives. Thus, the operator is enabled to maintain his lubricating oil without sacrificing any of the improved qualities made possible by present-day refining methods.

Oil can be cleaned at moderate temperatures, with the result that its stability is not impaired—the oil does not tend to break down and oxidation is not unduly hastened.

Oil life is increased, hence the total cost of oil over a period of time is reduced. Another important advantage is that ring sticking and bearing wear are minimized.

Crankcase inspection is facilitated inasmuch as when the "Puri-Filter" is installed in the lubrication system of an engine it is not necessary to clean out the crankcase at the time periodic inspections are made. Another cleaning opera-

Whatever your POWER NEEDS
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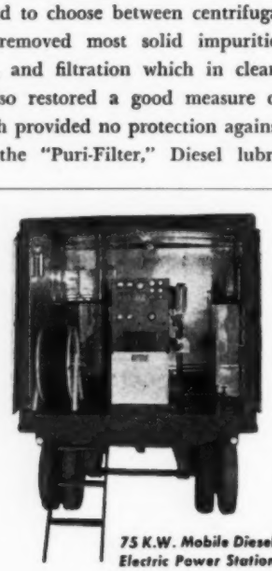

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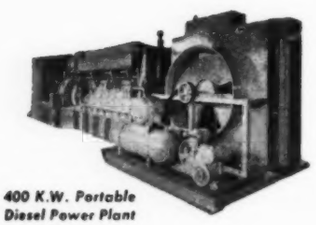

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tion facilitated by the use of the combination centrifuge and filter is that of cleaning the bowl of the purifier. Field experience showed that the unit can be operated for unusually long periods without bowl cleaning or cartridge replacement.

Lister-Blackstone Changes Manufacturing Setup

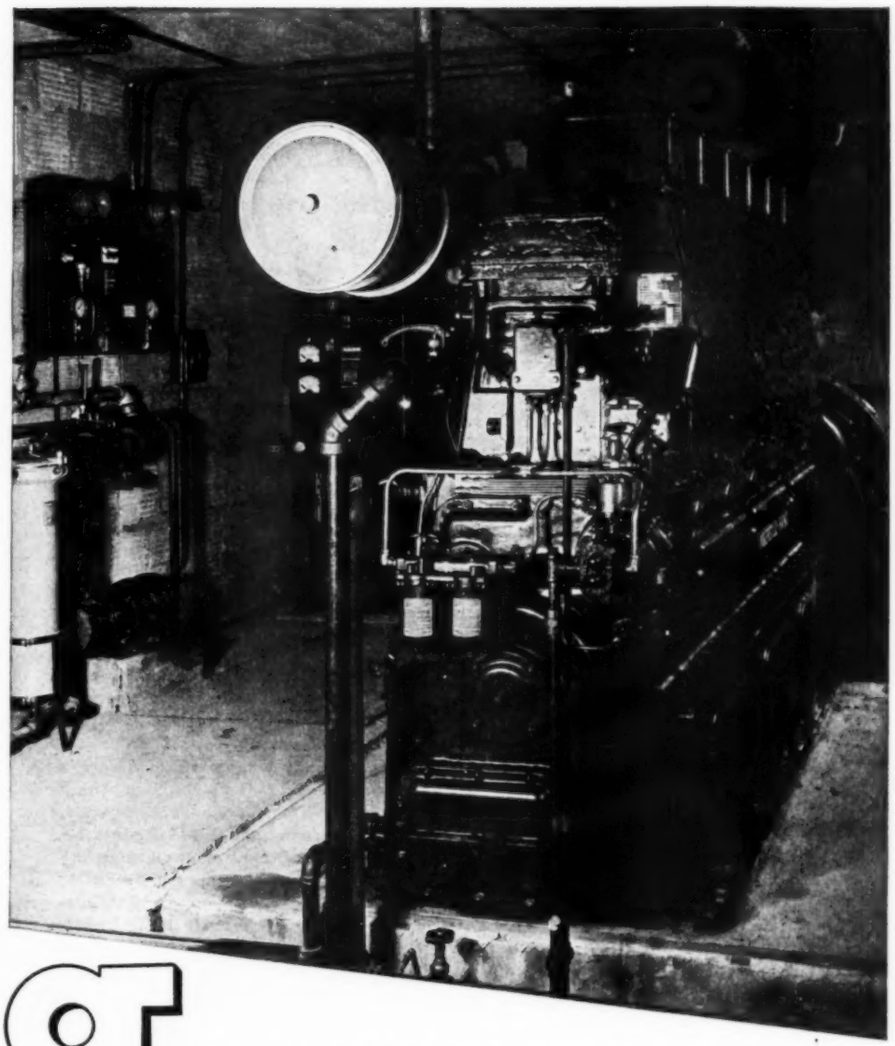
A COMPLETE new setup in the manufacture of its Diesel engines is announced by Lister-Blackstone, Inc. All production has been moved to a new modern plant equipped with the most up-to-date tools and machines. The change will result in greater production and even higher quality engines, according to F. Rankin Weisgerber, Executive Vice-President.

F. Rankin Weisgerber

A departure from its past policy will be an almost complete concentration on the production of the straight Diesel engines. While there will be some adaptations—such as power take-off and irrigation pump outfits and possibly marine propulsion units—no Diesel generator sets or combination auxiliaries will be produced. In the general field these will be built by electrical manufacturers who can more readily meet the exact requirements of customers. In the marine field, they will be handled by manufacturers along the coast lines who are in an ideal position for installation and service.

To streamline its part service a complete, modern parts department has been established at 1568 W. Pierce Street, Milwaukee.

All business will be transacted from a new downtown office at 740 N. Plankinton Avenue, Milwaukee 2, Wisconsin.



Guide to efficient engine operation
Alnor EXHAUST PYROMETERS

This six cylinder, 450 hp Ingersoll-Rand Diesel generator set supplies power for a chemical process where dependable, efficient operation is of the greatest importance. The Alnor Exhaust Pyrometer, providing for an easy routine check of exhaust temperatures helps the operators to maintain continuous, efficient engine performance. They know that an exhaust temperature record is an accurate guide to engine operation, and an efficient check on uniform loading as well as adjustments. There is an Alnor Pyrometer to meet the needs of any engine installation, large or small. Write for descriptive bulletins.

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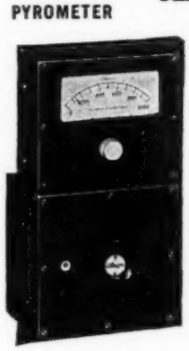

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Supercharging and Internal Cooling Cycle

. . . . *Continued from page 63* . . . .

high combustion pressures. This line is plotted for internal temperatures equal to those existing in the nonsupercharged engine at 100 mip and 765 psi combustion pressure. The initial compression temperature is 615 deg. R and the combustion pressure on this line is 53.6 times P_1 abs.

As an example, an engine may be operated with a supercharging pressure P_1 = 12 psig. The compression pressure would then be 895 psi and the combustion pressure 1430 psi (line 4). The mip would be 225 psi with T = 615.

With the inlet air cooled to 175 F. in the manifold, a blower pressure of 22 psig would be used. The internal cooling would be 57 F. by expansion to 12 psig. Cooling the blower-discharge air from 300 to 175 F. corresponds to a heat removal of 260 Btu. per bhphr. The combined heat removal from jacket water and supercharging air would then be 800 Btu. per bhphr., or about 11 per cent of the total heat in the fuel. The high mechanical efficiency with high mep will give a fuel consumption of about 0.35 lb. per bhphr.

Altitude Ratings

By selection of blower-discharge pressure and proper timing of the inlet-valve closing, engines equipped with the dual-pressure supercharging system will carry full sea-level rating at all altitudes. Engines permanently located at a fixed altitude are equipped with inlet cams timed to give the supercharging pressure (initial compression pressure) normally used at sea level. For high altitudes the blower may have a compression ratio of 2.5 to 1 which at 14,000-ft. altitude would give a manifold pressure of 21.55 psia. The internal expansion would be from 21.55 to 18.7 (normal sea-level supercharging pressure 4 psig).

Due to the lower internal-expansion ratio at altitude, the external cooling in the intercooler must be carried lower by the amount lost in internal cooling. Thus in the foregoing example internal cooling would be only 25 deg. F., and the manifold air must be cooled to 105 F. to carry a rating of 130 bmep. with a supercharging pressure of 18.7 psia at 14,000-ft. altitude.

To maintain sea-level horsepower in an engine operating, for instance, in a Diesel locomotive over mountain ranges or varying altitudes, one of the following methods is used:

1. A mechanism which varies the closing of the inlet valve with respect to piston position by automatic or manual control in such a manner that the initial compression pressure is maintained substantially constant. This system requires increased intercooling to decrease the manifold temperature with increasing altitude.

2. In another method the inlet-valve closing angle remains fixed, and the blower-discharge pressure is decreased with decreasing altitude by throttling the intake or by-passing the blower or turbine.

Either of these methods may also be used to improve part-load operation, part load being treated as an increase in altitude.

Summary

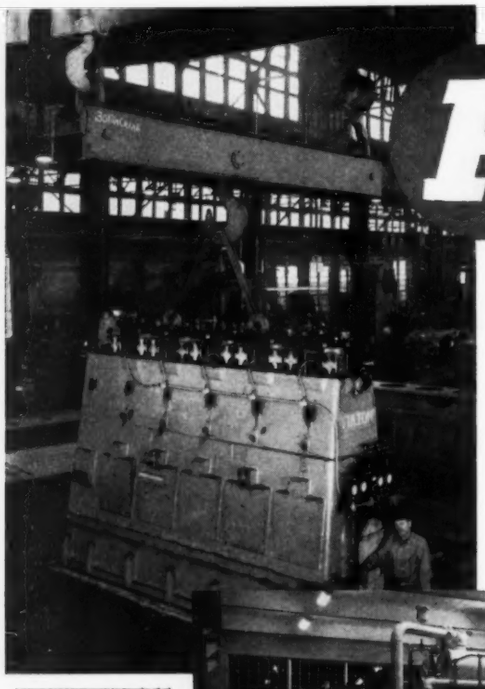
The dual-pressure supercharging system may be classified in accordance with temperature and pressure conditions in three groups, as follows:

1. Operating without intercooling between blower and inlet manifold. Combustion pressures limited to the same as in the nonsupercharged engine.
Bmep in per cent of nonsupercharged rating = 140

2. Operating with intercooling to give minimum permissible initial compression temperature. Combustion pressure limited to the pressure in the nonsupercharged engine.
Bmep in per cent of nonsupercharged rating = 175

3. Operating with intercooling to give minimum permissible initial compression temperature. Ratio of combustion pressure to compression pressure same as in nonsupercharged engine.

. . . . *And now please turn to page 86* . . . .



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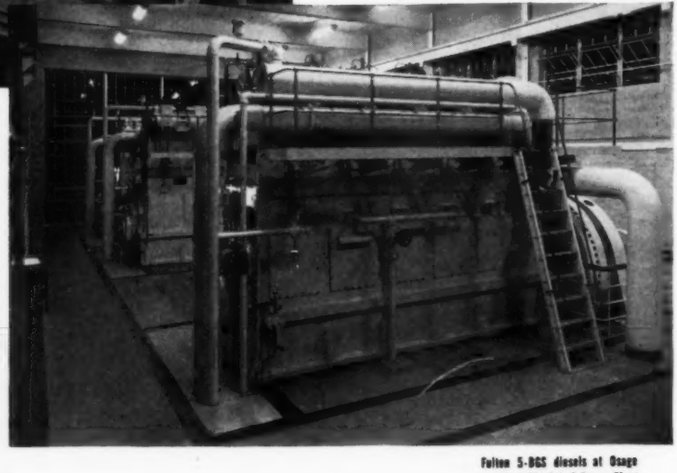
Fulton 5-DGS diesel being loaded for shipment to U. S. S. R.



Fulton 5-DGS diesels at Osage Iowa Municipal Power Plant

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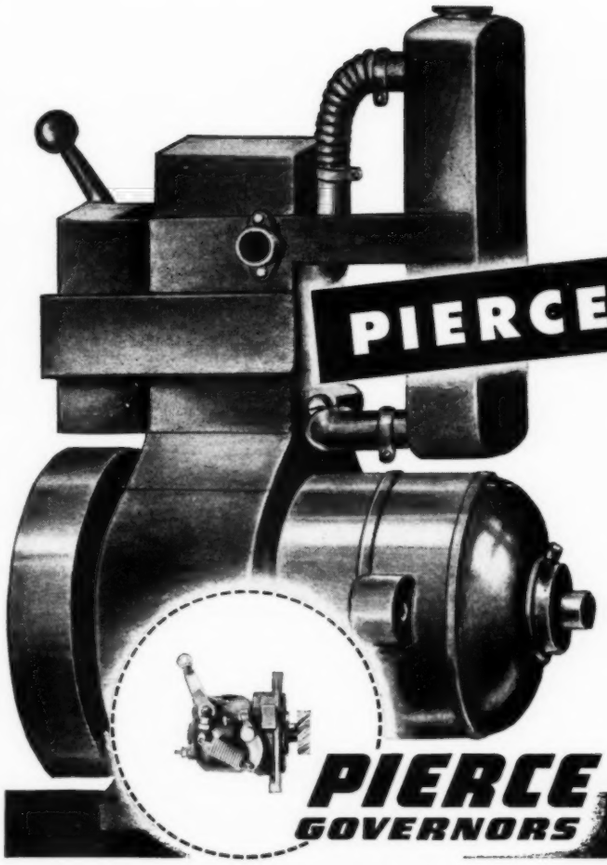

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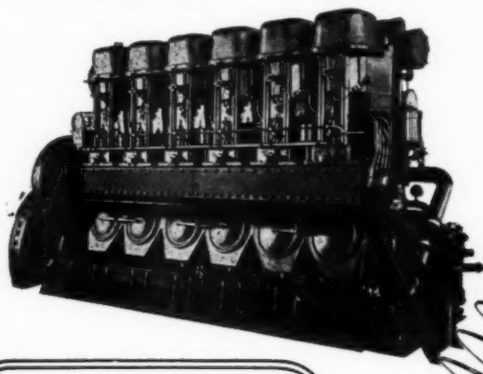

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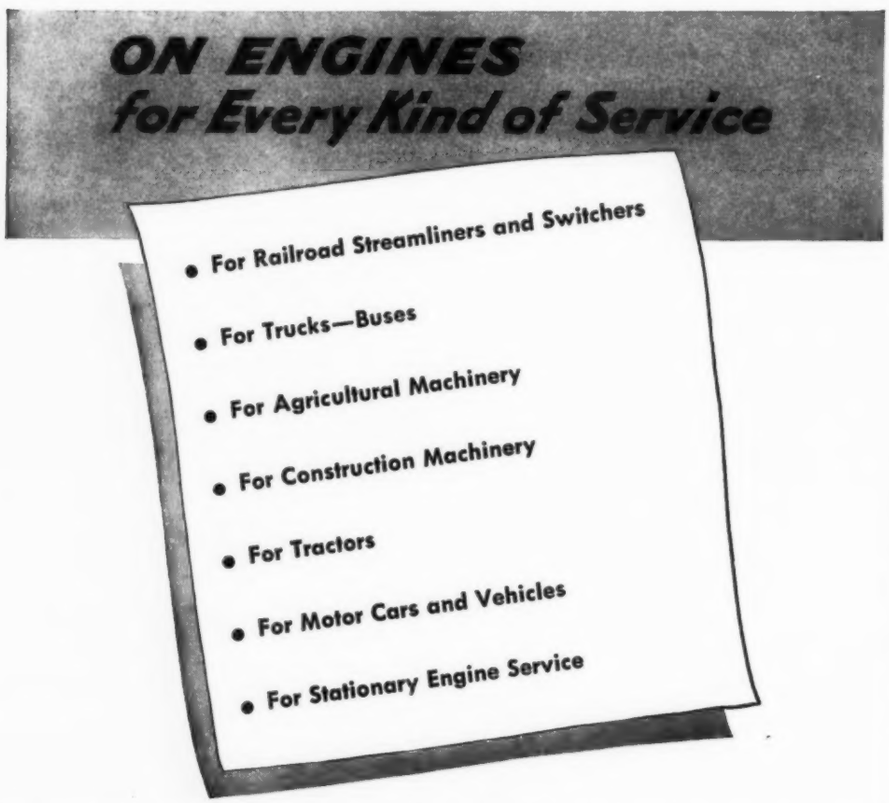
. . . . *Continued from page 84* . . . .

Bmep in per cent of nonsupercharged rating = 200

By selecting high manifold pressures and large expansion ratios on the intake stroke, the minimum permissible initial compression temperature for operation under 2 and 3 may be obtained with a manifold air temperature as high as 200 F., which permits using the engine cooling water in series through the air intercooler.

Dual-pressure supercharging of spark-ignition Otto-cycle engines increases the power output considerably more than in the compression-ignition engine because the initial compression temperature can be carried to lower levels. Scavenging adds a greater percentage to the air retained in the cylinder. The compression ratio may be increased.

IF YOU HAVEN'T ORDERED YOUR COPY OF THE 1946 DIESEL ENGINE CATALOG, VOL. 11, BETTER DO IT TODAY, SEE Page 110.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In the MICHIANA line you will find the type and capacity for application to the gasoline or Diesel engines you use . . . MICHIANA PRODUCTS CORPORATION, Michigan City, Indiana.

Above: MICHIANA (Diesel) Oil Filter. Capacities to 3266 H.P.

Right: MICHIANA (Gasoline engine) Oil Filter.

Write for Bulletin 45-D

MICHIANA
OIL FILTERS

Large Exhibits of Diesel Engines To Be Displayed at Second Annual Meeting Marine Exposition

WORTHINGTON Pump and Machinery Corporation and the Nordberg Manufacturing Company have taken over twelve hundred square feet in which to display Diesel engines in the first National Marine Exposition ever to visit the Pacific Coast.

Under the sponsorship of the Propeller Club of the United States and the management of National Marine Expositions, Inc., the second annual National Marine Exposition will be held in the Civic Auditorium, San Francisco, May 12th-17th, 1947. Its predecessor, held last May in Grand Central Palace, New York City, where this "National Market Place of the Marine Industry" will be held on alternate years, was acclaimed by marine trade papers, press, public and exhibitors alike: "An outstanding achievement in maritime history."

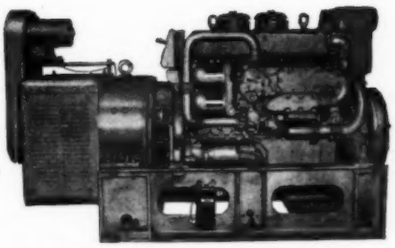
Two hundred leaders in every branch of the marine industry displayed their equipment, products and services to visitors from 32 states and 25 foreign countries. The last day of the 1946 exposition witnessed the unprecedented sight of exhibitors contracting for over 10,000 square feet of exhibit space in the 1947 show.

To date, with six months still to go, fifty leading concerns in the marine industry have contracted for more than half of the available exhibit space. A veritable "Who's Who" of the marine industry will again—as they did in New York City last May—display to the thousands of buyers and the general public the latest developments and improvements in marine equipment, design, machinery, furnishings, products and services.

Write For New Caterpillar Booklet

CATERPILLAR Tractor Co. has published a new booklet, "Caterpillar" Diesel Electric Sets, in which the attributes of the product are featured along with picture stories of the sets in operation. The booklet gives terse coverage of the specifications and distinctive features of the electric sets and illuminates such treatment with adequate illustrations.

It spotlights time-tested applications as electric power plants for small communities, logging camps, dairies, mines, chick hatcheries, ice companies, radio broadcasting companies, ranches. Copies of the booklet may be obtained by writing "Caterpillar," Peoria, Illinois, requesting Form 9321.



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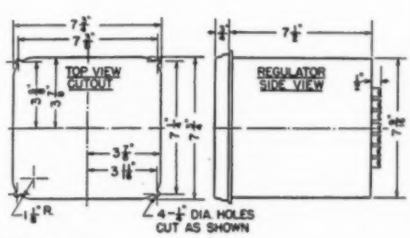
Inquiries for complete information and engineering service are solicited.



BURLINGTON INSTRUMENT CO.
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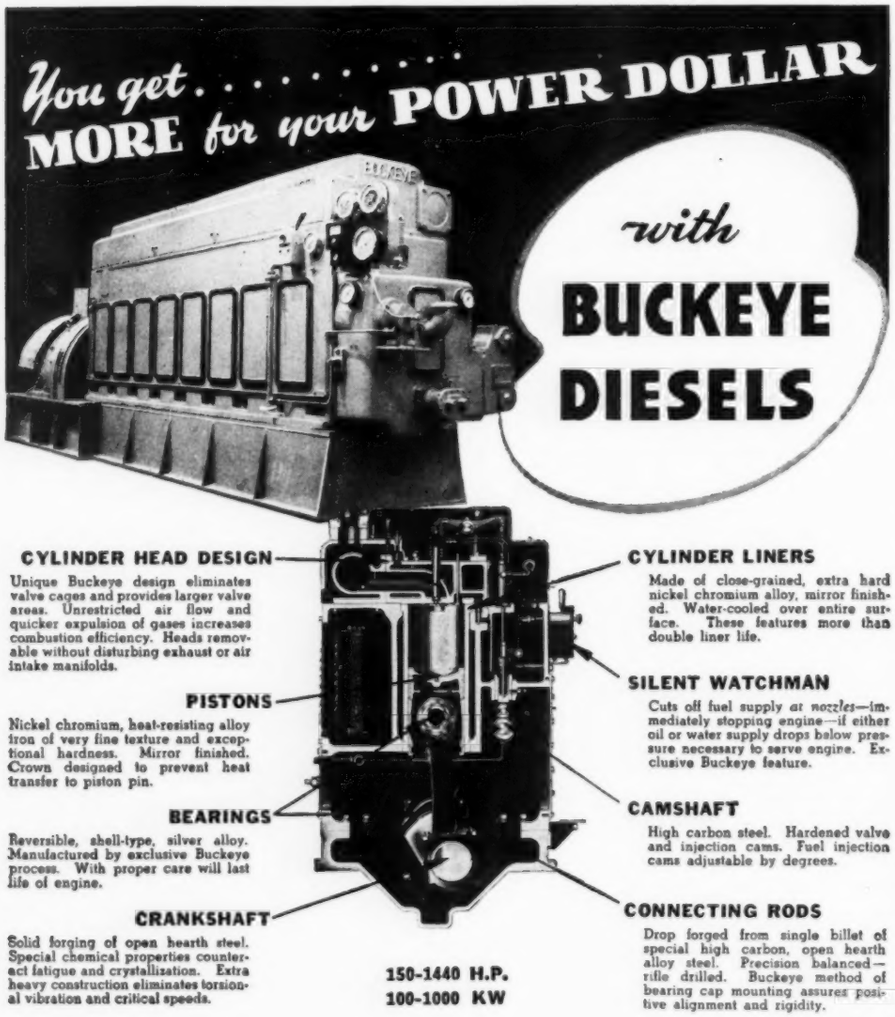
New Appointments by Young Radiator Co.

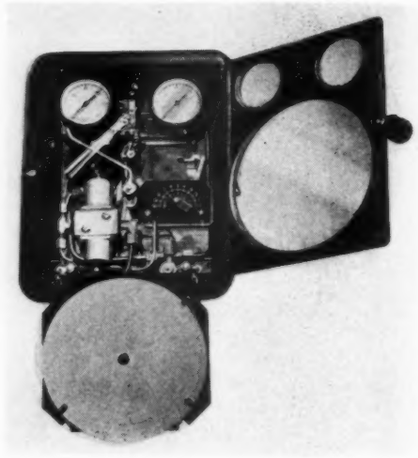
TWO new appointments, one of a new Service Manager and the other a special representative have recently been announced by the Young Radiator Company.

Peter J. Fink, new Service Manager, has filled various preparatory positions with Young for the past several years. Prior to his association with Young he has been active in Cost work, Direct Sales and Trouble Shooting, thereby being ably qualified to fill his new position. Lloyd B. Smith, special representative in the Pacific Northwest territory possesses excellent qualifications to serve Young Radiator Company's customers. A graduate of the University of Washington he has over 30 years experience in commercial and industrial work.

Peter J. Fink • *Lloyd B. Smith*


You get . . . . . MORE for your POWER DOLLAR
with
BUCKEYE DIESELS
CYLINDER HEAD DESIGN
Unique Buckeye design eliminates valve cages and provides larger valve areas. Unrestricted air flow and quicker expulsion of gases increases combustion efficiency. Heads removable without disturbing exhaust or air intake manifolds.
PISTONS
Nickel chromium, heat-resisting alloy iron of very fine texture and exceptional hardness. Mirror finished. Crown designed to prevent heat transfer to piston pin.
BEARINGS
Reversible, shell-type, silver alloy. Manufactured by exclusive Buckeye process. With proper care will last life of engine.
CRANKSHAFT
Solid forging of open hearth steel. Special chemical properties counteract fatigue and crystallization. Extra heavy construction eliminates torsional vibration and critical speeds.
CYLINDER LINERS
Made of close-grained, extra hard nickel chromium alloy, mirror finished. Water-cooled over entire surface. These features more than double liner life.
SILENT WATCHMAN
Cuts off fuel supply at nozzles—immediately stopping engine—if either oil or water supply drops below pressure necessary to serve engine. Exclusive Buckeye feature.
CAMSHAFT
High carbon steel. Hardened valve and injection cams. Fuel injection cams adjustable by degrees.
CONNECTING RODS
Drop forged from single billet of special high carbon, open hearth alloy steel. Precision balanced—rifle drilled. Buckeye method of bearing cap mounting assures positive alignment and rigidity.
150-1440 H.P.
100-1000 KW
Every feature of Buckeye design and construction has been developed to bring the highest standards of dependability and economy to users of Diesel power.
Write today for your Buckeye catalog. Our engineering staff is always at your service. No obligation.
MARINE
STATIONARY
"Be Profit-Wise and Dieselize with Buckeyes"
THE BUCKEYE MACHINE CO.
LIMA . . . . . OHIO
Engine Builders Since 1908

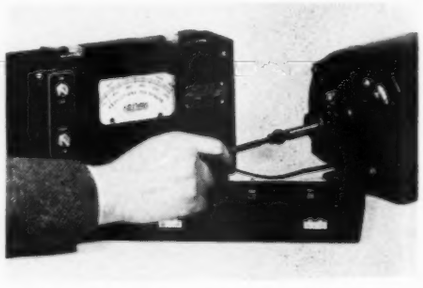
New Precision Recorder By Gotham Instrument Co.



Gotham Recorder-Controller

INFORMATION on a new, specially designed recorder-controller was recently released by the Gotham Instrument Company. The new design features the patented Gotham proportioning quick-response relay (PQR) which is so designed that the slightest change of the controlled element will bring an immediate proportionate response of the diaphragm valve regardless of the distance of the diaphragm from the control instrument. The recording mechanism has the same bourdon type spring movement, tubing and bulb specifications as Gotham's larger units. The dimensions of the unit are 7¾ x 10 inches. For further information write the Gotham Instrument Co., Inc., 149 Wooster St., New York 12, N. Y.

Portable Synchronous-Speed Tachometer



Metron Synchronous-Speed Tachometer

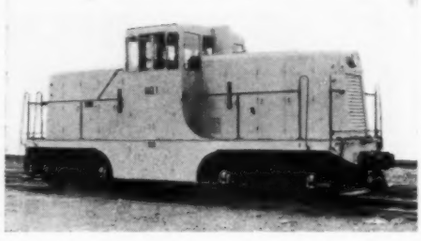
THE Metron Instrument Company is now producing Synchronous-Speed Tachometers for

measuring speeds at approximately the two synchronous speeds of 1800 and 3600 rpm. The head of these tachometers is a simple contact-making mechanism operated by the rotation of the spindle. This contact mechanism periodically charges a condenser through a DC milliammeter which indicates the average current.

Operation is from the 115 volt AC power line without vacuum tubes. The tachometers are stabilized against line voltage variations. For further information write the Metron Instrument Company, 430 Lincoln St., Denver 9, Colorado.

Diesels Make Short Line Railroads Pay

THE smaller railroads of the United States are taking hold of the idea of Dieselization in a big way. According to P. M. Gillilan of General Electric's Transportation Divisions, 28 Class II and III railroads are now using the 380 hp. 44 ton Alco-G.E. Diesel-electric locomotives. From all over the country comes the news. The Springfield Suburban Railroad of Springfield, Ohio, a three mile switching line, was completely Dieselized recently with the delivery of 2 of these 44-ton Diesel-electrics. Up in Hopedale, Mass., the 15-mile Grafton and Upton Railroad bought two of these new Diesels. In the South, the Laurinburg and Southern Railway recently began a Dieselization program.



Alco G.E. Diesel-electric Locomotive powered by Twin Caterpillar Diesels.

In some cases, these Dieselization programs have meant the difference between abandonment of the line and profitable operation. The savings resulting from Diesel operation in fuel cost and maintenance expense has meant this difference between success and failure.

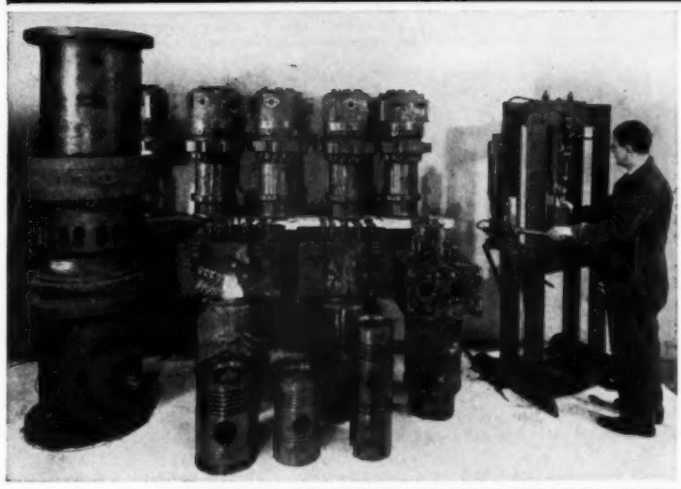
The Alco-G.E. locomotive is a four axle, 380 hp. unit equipped with two Caterpillar Diesels rated at 190 hp. each at 1000 rpm. Direct-connected to the engine flywheel through a flexible steel-disk coupling are two shunt-wound D.C. generators, which drive four traction motors. A starting tractive effort of 26,400 lbs. is attained.

H. W. RAMBERG, Inc.

SHIP REPAIRING

37 VAN DYKE ST BROOKLYN, N. Y

SHOP PHONES CUMBERLAND 6 { 3960 3961



DIESEL

Overhauling, Repairing, and Redelivering.

. . .

Foreign and Domestic Pistons, Liners, Cylinders, Covers, Valves, etc.

PIONEERS IN DIESEL REPAIR WORK SINCE 1919

LET US SOLVE YOUR DIESEL PROBLEMS

Fabricators and Reconditioners of both Domestic and Foreign makes.

. . .

Fuel Valves, Pumps, Valve Plungers, and Housings.

. . .

Cams and Rollers, Oil Filters, Gears, Injectors, Atomizers and Nozzles.

. . .

Telescope Pipes, Governors, Pistons and Lubricators.

. . .

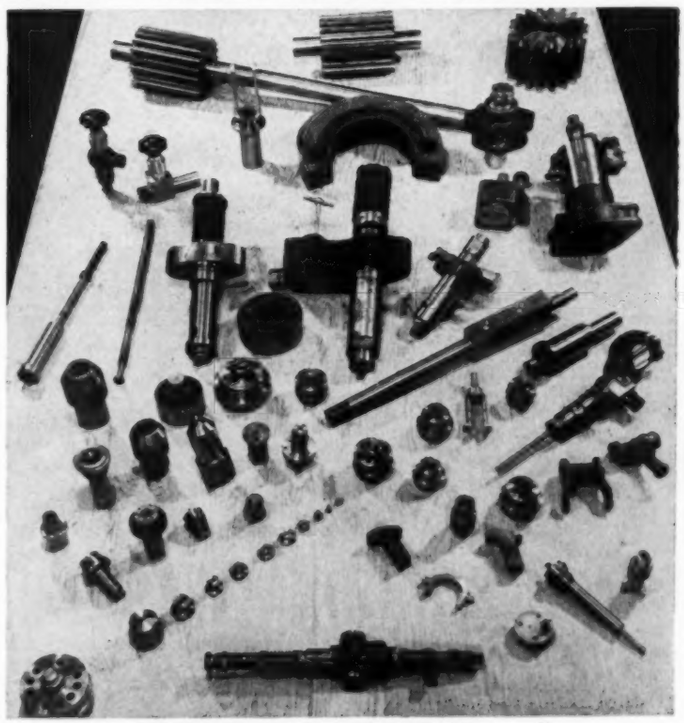
H.P., M.P., and L.P. Compressor Valves, Cylinders, Pistons.

. . .

Slide, Exhaust, Inlet and Starting Valves.

. . .

Inlet and Exhaust Spindles.



DIESEL SPECIALTIES, Inc.

2 VAN DYKE ST. TELEPHONE: CUMBERLAND 6-3965 BROOKLYN, N. Y.

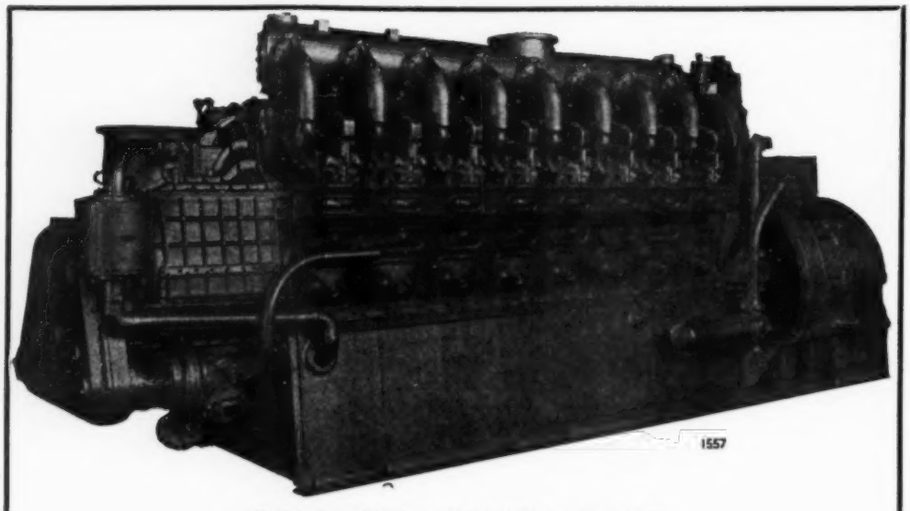
Glen Boyer to Missouri School of Mines

GLEN C. BOYER, nationally-known consulting engineer, joined the faculty of the Missouri School of Mines and Metallurgy as an associate professor of Mechanical Engineering on September 1, 1946. For 16 years, Boyer was an associate engineer on the staff of Burns and McDonnell Engineering Company, consulting engineers, where his professional activities included the design of Diesel and steam power plants as well as electric distribution systems in many sections of the United States.

In addition to designing power plants and electric distribution systems, he was called upon to make investigations of existing installations in Mexico and Alaska as well as the United States.

Boyer is a member of both the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. At the present time he is a member of the executive committee of the Oil and Gas Power Division of ASME as well as the Internal-Combustion Engine Test Code Committee of ASME. He is registered to practice professional engineering in Missouri, Ohio, Indiana, and Michigan.

He has written extensively for many of the leading technical magazines in the United States as well as for the Oil Engine, published in England. He has also written a well-known book "Diesel and Gas Engine Power Plants" dealing with the design and operation of internal-combustion engine power plants.



1600 H.P. General Motors Model 16-278-A 720/750 rpm

93,780 DIESEL HORSE POWER—IMMEDIATE SHIPMENT

MARINE DIESEL—ELECTRIC UNITS—COMPLETE—1944 GENERAL MOTORS DIESELS—
ALLIS CHALMERS—WESTINGHOUSE ELECTRICAL EQUIPMENT

6400 H.P. FOUR ENGINE UNIT—TWIN SCREW
3200 H.P. TWO ENGINE UNIT—SINGLE/TWIN SCREW
1600 H.P. SINGLE ENGINE UNIT—SINGLE SCREW

ENGINES, GENERATORS, PROPULSION MOTORS, CONTROLS, TAIL SHAFTS, BEARINGS, THRUSTS AND PROPELLORS.

A.C. DIESEL GENERATOR UNITS—60 CYCLE—50 CYCLE

KVA	H.P.	MAKE	RPM
2—1875	2000	FAIRBANKS	300
1—1250	1500	NELSECO	300
2—1250	1600	FAIRBANKS	720
10—1250	1600	GEN. MOTORS	720
4—1000	1200	GEN. MOTORS	600
1— 625	750	SUPERIOR	327
5— 375	450	GEN. MOTORS	600
2— 375	450	ALCO (MACK)	360
1— 375	450	ENTERPRISE	450
1— 300	360	FAIRBANKS	257
5— 250	300	GEN. MOTORS	900
4— 250	400	GEN. MOTORS	1200
2— 200	240	FAIRBANKS	257
1— 156	190	BUCKEYE	514
2— 127.5	165	MURPHY	1200
4— 125	150	GEN. MOTORS	1200
1— 92.5	112.5	BUCKEYE	400
18— 75	90	GEN. MOTORS	1200
15— 62.5	80	INTERNATIONAL	1200
38— 37.5	60	INTERNATIONAL	1200
3— 32	45	INTERNATIONAL	1200
28— 18.75	38	INTERNATIONAL	1200

D.C. DIESEL GENERATOR UNITS—2 WIRE—3 WIRE

KW	H.P.	MAKE	RPM
12—1000	1600	GEN. MOTORS	750
2— 800	1250	McINTOSH-SEY.	250
3— 500	750	GEN. MOTORS	750
3— 300	450	GEN. MOTORS	600
1— 300	450	GEN. MOTORS	1200
6— 275	440	COOPER BESS.	800
3— 250	450	ENTERPRISE	450
4— 250	450	WORTHINGTON	450
4— 100	150	SUPERIOR	1200

SMALLER UNITS TO 10 KW

PORTABLE POWER UNITS—15 H.P. to 400 H.P. RADIATOR COOLED — WITH CLUTCH POWER TAKE OFF

WHAT ARE YOUR REQUIREMENTS?

A. G. SCHOONMAKER COMPANY

BUSINESS ESTABLISHED 1898

ENGINEERING— DIESEL ENGINES —SALES

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Cable Address: AGSCOMACH Shops & Warehouses, Jersey City, N. J.

General Motors to Expand Diesel Locomotive Production

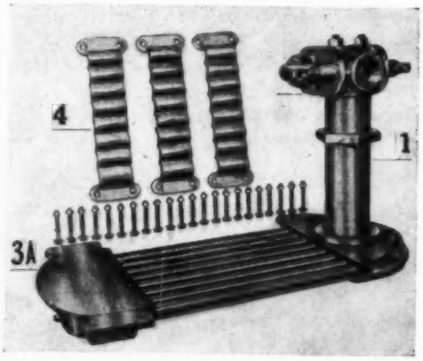
ELECTRO-MOTIVE Division of General Motors has leased the property known as the Pullman Airplane Wing Plant, 103rd Street and Cottage Grove Avenue, Chicago, from the War Assets Administration, as one of several moves to increase capacity to manufacture Diesel locomotives to a rate commensurate with the anticipated demand by American railroads. The 103rd Street plant is a one-story, brick, steel and concrete structure with more than 600,000 square feet of floor space.

Erection of locomotives and most of the manufacturing work will continue at the La Grange plant which now will be known as Plant No. 1. The leased building will be known as Plant No. 2. The new space will be used for the fabrication of many of the sub-assemblies now built in the main plant.

E. V. Rippingille

E. V. Rippingille, Jr., is the newly appointed Plant Manager of Plant No. 2 of Electro-Motive Division of General Motors. In May, 1937, he joined Electro-Motive as a foreman in charge of the blower manufacturing department. A few months later he became Assistant Plant Engineer. In June, 1942, he became Assistant Factory Manager, holding that title until his present promotion.

Outboard Cooling System for Marine Engine Installations



Assembly parts of Walter Clean-Flo cooler. Key: 1. Inlet fitting; 3. Return fitting; 4. Clamps.

THE G. Walter Machine Company offers an efficient system of outboard water cooling which utilizes cooling coils on the outer skin of the ship. This permits the cooling of engine jacket water by direct contact with sea water through the outboard cooling coils. Only one opening in the hull is needed for the installation of this type of cooler since the inlet and outlet connections are incorporated in one pipe. These "Clean-Flo" coolers, sometimes called keel coolers, utilize the regular engine water circulating pumps. The coolers are supplied in sizes determined by the engine pump capacity from ½" to 2". The tubing is either hard drawn copper or in special cases, admiralty antimony. This tubing is soldered at the joints when it is installed. Thermostatic controls are available for all coolers. For further information write the G. Walter Machine Company, 84 Cambridge Ave., Jersey City 7, N. J.

Pennson Corporation Purchases The McIntyre Company

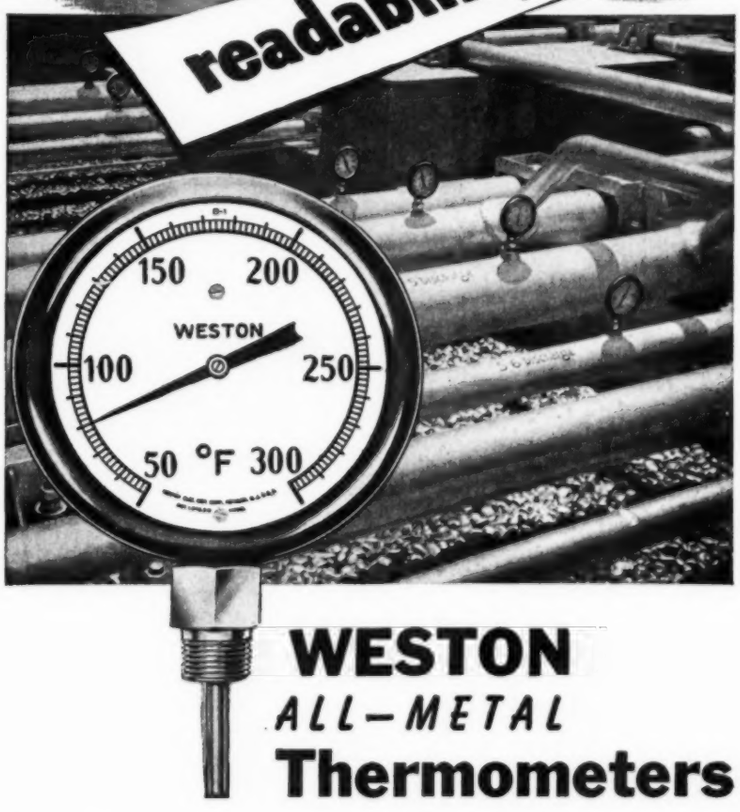
THE Pennson Corporation recently announced the purchase of The McIntyre Company of Newton, Massachusetts. This is the Pennson Corporation's second acquisition and is to be combined with its first purchase, the Waltham Horological Manufacturing Company of Waltham, Massachusetts, manufacturers of precision parts. The McIntyre Company is a manufacturer of precision industrial hydraulic and water pumps and fluid motors.

George P. Robinson, president of the Pennson Corporation, has announced that Eben S. Upton, vice president and Douglas Sloane, treasurer of the parent corporation will join R. Louis Towne, general sales manager and Charles Kester, production manager of The McIntyre Company as an executive committee, which will administer policies of the two combined companies.

Combines the two

RELIABILITY

readability



WESTON

ALL–METAL

Thermometers

The legible, wide open scale on the WESTON thermometer permits you to take full advantage of its inherent, long-time accuracy. Even from a distance, readings can be made "right on the nose."

WESTON thermometers are available in a variety of types, stem lengths and scale ranges for most industrial applications. If your jobber cannot supply you, see your local WESTON representative, or write for Thermometer Bulletin . . . Weston Electrical Instrument Corporation, 679 Frelinghuysen Avenue, Newark 5, New Jersey.

MAX-MIN models also available to indicate highest or lowest temperature reached.

Weston *Instruments*

Marine Lubricants Subject of New Sinclair Booklet

IN a new booklet recently released by the Sinclair Refining Company, there is much valuable information for ship operators and engineers. Stressing the fact that modern ships present diverse and complicated lubrication problems, the booklet cites the examples of modern turbine and Diesel installations which require specialized lubricants. Lubrication charts for various types of vessels are supplied including Liberty ships, Victory ships, T2-SE-A1 tankers, and the C1-M-AV1 Diesel cargo vessels. Other portions of this 32 page booklet are devoted to descriptions of the various Sinclair marine oils and their applications. Sinclair Tenol is recommended for Diesel lubrication as it possesses the characteristics of detergency, dispersion, anti-oxidation, and anti-foaming. Sinclair Gascon oil is also designed for Diesel lubrication. Perhaps the most interesting section of the booklet is that devoted to the specifications and tests applied to lubricating oils and greases. All of the commonly used tests are explained briefly along with their significance. The booklet may be had on request by writing the Sinclair Refining Company, 630 Fifth Ave., New York 20, N. Y.

Mountings, power take-off and other details of this Fidelity AC Generator can be adapted by our designers to your engine design specifications. New Zanderoll process of applying insulating varnish helps to make Fidelity the last word in modern electric generators.

More Coming...

INCREASED plant facilities, plus increased availability of critical materials, are making more Fidelity Generators available for delivery this winter than we had anticipated a few months ago. Long established reputation for quality will NOT be sacrificed. In fact, these will be better pieces of equipment than we have ever produced before.

Old customers will, of course, have first chance at this increased production capacity, but we are setting aside some of it to build up a few new accounts. Stable manufacturers, who are interested in a stable source of supply for the future, are invited to get in touch with us.

FIDELITY ELECTRIC COMPANY, INC.

330 North Arch St., Lancaster, Pa.

Fidelity ELECTRIC GENERATORS

Beck Appointed Acting General Sales Manager for Cummins

Leonard W. Beck

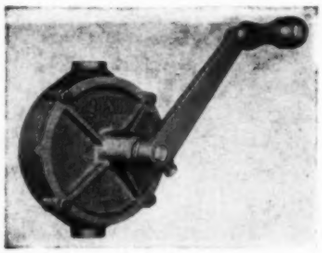
APPOINTMENT of Leonard W. Beck as Acting General Sales Manager of the Cummins Engine Company, Inc., was announced recently by R. E. Huthsteiner, Vice-president, Assistant General Manager and Controller. Mr. Beck's new responsibilities will be the overall administration of the Distribution Division (Sales and Service).

While Mr. Beck also will continue as Manager of the company's Central Region, his offices will be at the factory in Columbus, Indiana. Mr. Beck has been with the Cummins Diesel organization since 1938, and, prior to his new appointment, was Manager of the Central Region, with offices in Chicago, a position to which he was appointed in 1939.

Waste Heat Recovery Subject of Sims Bulletin

IN a new booklet the Sims Company describes the characteristic savings obtained by the use of heat recovery apparatus with internal combustion engines. Citing actual installations in laundries, power plants, cafeterias and dairies where appreciable savings have been made, the booklet goes on to describe the heat recovery equipment built by the Sims Company. The exhaust gas boilers are built to carry up to 100 psi. and can be supplied for engines of 70 bhp. up to 6500 bhp. The booklet also describes the company's heat exchangers which are built in sizes suitable for engines of 40 to 1500 hp. Copies of the booklet are obtainable from the Sims Company, P. O. Box 1096, Erie, Pa. Ask for Booklet HR-2—9-46-5M.

New Rotary Hand Pump



New 10 gpm. Bowser pump.

A NEW rotary hand pump has been designed by Bowser, Inc. engineers and on which laboratory and field tests were recently completed, according to J. B. Trotman, General Manager of the Industrial Pump Division of Bowser, Inc. This new rotary pump has a capacity of 10 gpm. at a normal cranking speed and is of the vane type with an aluminum rotor, graphite carbon vanes, and stainless steel springs are used. Suction and discharge ports are threaded for ¾-inch iron pipe. The rustproof working parts are said to eliminate the "freezing" action of rust due to condensation within the casing when the pump is not used frequently.
For further information write Industrial Pump Division, Bowser, Inc., Fort Wayne, Indiana.

Exhibitors from 20 States Enter National Motor Boat Show So Far

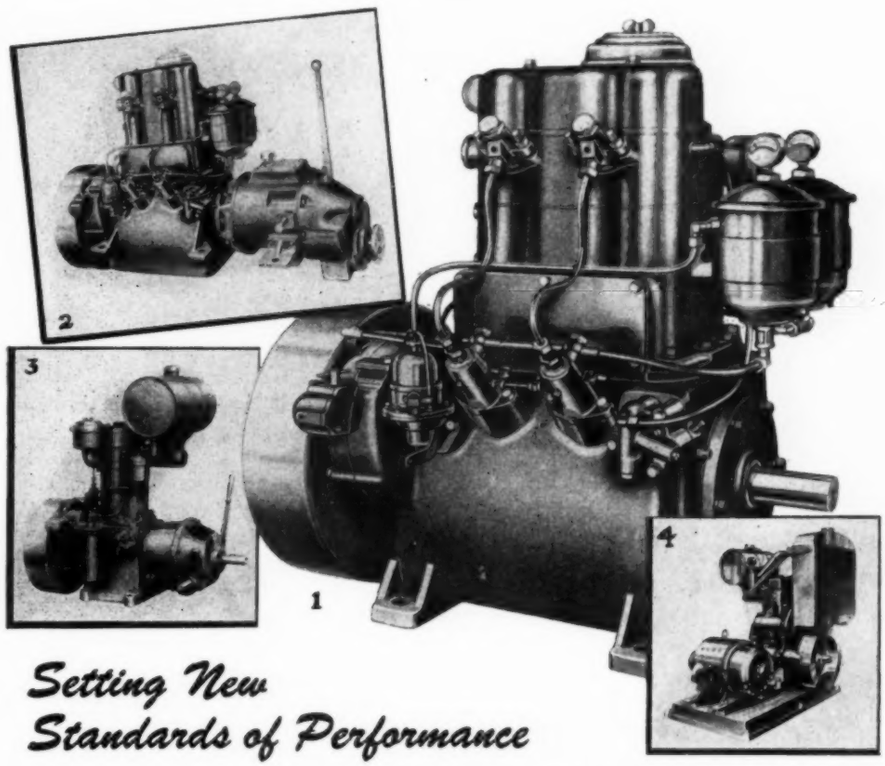
INDICATIVE of widespread interest in the coming 37th annual National Motor Boat Show at Grand Central Palace, Ira Hand, show manager, recently announced that better than 20 states will be represented among the exhibitors when the country's largest exposition of boats, marine engines and nautical accessories starts its eight day run on Friday, January 10. The show will remain open until Saturday, January 18, with the exception that it will be closed Sunday, January 12.

Exhibiting firms from as far away as the West Coast states of Washington and California, will appear at the show, as well as those from the south, mid-west and east, Mr. Hand said, and this nation-wide representation will include both large and small recreational craft, gasoline inboard and outboard motors, heavy and lightweight Diesel engines. All types of marine accessories, from manufacturers in widely scattered regions will, as usual, form an important section of the departmentalized show.

The annual luncheon meeting of the National Association of Engine and Boat Manufacturers, sponsors of the show, will be held on Friday, January 17, Mr. Hand announced.

Diesel School Gets Title To $2,800,000 In Diesel Equipment

COMPLETE title to Diesel engines and equipment valued at $2,800,000 and installed at North Carolina State College, Raleigh, N. C., during the Navy's program of Diesel engine training during the war, has been turned over to the school, the Navy Department has just notified college officials. The engines and equipment are housed in a $200,000 building which was erected especially for that purpose by the State of North Carolina.



Setting New Standards of Performance

IN A WIDE RANGE OF APPLICATIONS

For whatever purpose a small prime mover may be required, there's a Hallett Diesel Engine to supply efficient, dependable power at minimum cost. Single and two cylinder units of 8 and 18 horsepower respectively; small, rugged and compact; combining the most advanced Diesel engineering with the utmost simplicity in operation and maintenance; ideally adapted to all power, lighting and marine applications. The Hallett engineering department is available to power users to render assistance on all types of applications. Write for Bulletin and detailed information.

1: Hallett two-cylinder Diesel Stationary Engine. 2: Hallett two-cylinder Diesel Marine Engine. 3: Hallett single-cylinder Diesel Stationary Engine. 4: Hallett Diesel-Electric Generating Set.

HALLETT MANUFACTURING COMPANY

New York — INGLEWOOD, CALIFORNIA, U.S.A. — Detroit — Glendale

Cable Address: HALMFG. — Established 1916 — Code: Bentley's

HALLETT *Diesel* ENGINES

"BUT WHAT'S YOUR LAST NAME?"

Our last name is *Koppers*. Many of you know our "children" by their "first names," but do you know their last name?

That is important to us, and it's important to you, too.

Many of you vouch for the extra service you get from Fast's Self-aligning Couplings or American Hammered Piston Rings, or White Tar insecticides or D-H-S-Bronze . . . and don't know that their last name is Koppers. If you know, you are probably disposed to put more than ordinary trust in other products made by Koppers.

Did you know that you can get a Koppers product for coating metal surfaces to prevent corrosion? A Koppers material that makes roofs last longer? Lumber that defies decay and termites? And many other products made with the same skill and originality and inventiveness as those?

So . . . look for this trade-mark which will soon be found on all Koppers products. Here it is.

K
KOPPERS

It is the mark of an organization which is engaged in many phases of engineering, construction, chemistry and coal carbonization . . . is in the forefront of new synthetic developments . . . is an important supplier to the pharmaceutical industry and to many other industries. For top value, look for this mark. Koppers Company, Inc., Koppers Building, Pittsburgh 19, Pennsylvania.

THE INDUSTRY THAT SERVES ALL INDUSTRY

For example...for the power industry

Among the principal products Koppers provides for the power industry are:

Fast's Self-aligning Couplings for dependable power transmission.

Piston Rings . . . in every size—of every type—for every purpose.

Bearing Seal Piston Rings.

Metallic rod, wiper and pressure packing.

Pressure-treated piling for building and machinery foundations.

Pressure-treated lumber for general construction, protected against decay, termites, marine borers, fire and acid attack.

Coal Tar Pitch waterproofing and dampproofing for foundations, retaining walls, etc.

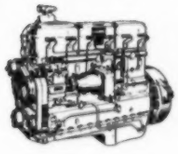
Plastipitch Protected Metal for roofing, siding, gutters, downspouts.

Pitchmastic Flooring Compound.

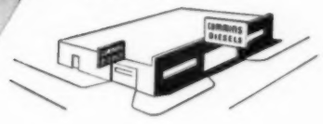
Bituminous-base paints and coatings.

dependable

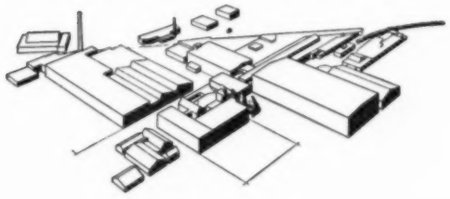
THE ENGINE



THE DEALER



THE MANUFACTURER



a dependable engine . . . proven dependable and economical on jobs such as yours.

a dependable dealer . . . near you . . . on call 24 hours a day with adequate parts and dependable mechanics.

a dependable manufacturer . . . who puts quality ahead of quantity . . . who recognizes that service comes ahead of sales.

CUMMINS Dependable DIESELS

SINCE 1919...PIONEER OF PROFITABLE POWER THROUGH HIGH SPEED DIESELS

CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA

RITCO

SPECIAL STUDS AND NUTS

This locomotive stud by RITCO is made for reliable service under heavy loading. Uniform in strength with precise, clean cut threads, RITCO special bolts and studs are produced accurately to your specifications in any metal . . . ground or unground . . . bolts to 2" diameter, nuts to 3".

Remember RITCO for

SPECIAL BOLTS, NUTS AND STUDS
ALLOY STEEL STUDS • MILLED BODY BOLTS
DROP FORGING • HEAT TREATING
DIESEL ENGINE BOLTS AND STUDS
Let us quote on your specifications.

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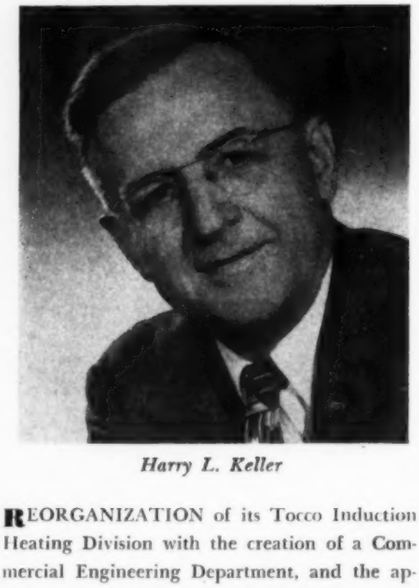
SINCE 1834

Keller Heads Tocco Engineering Department



Harry L. Keller

REORGANIZATION of its Tocco Induction Heating Division with the creation of a Commercial Engineering Department, and the appointment of five men to new positions was announced recently by Wm. E. Benninghoff, General Manager of the Tocco Division of the Ohio Crankshaft Company.

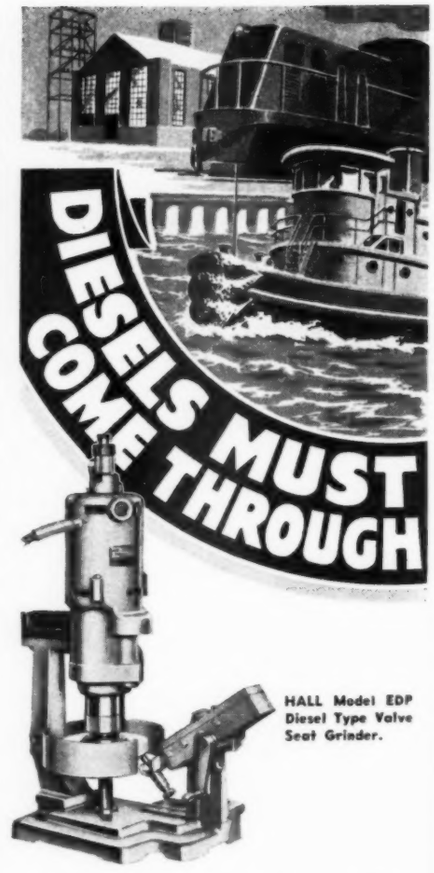
Coming as head of the new Tocco Commercial Engineering Department was Harry L. Keller, Automotive Production Engineer in charge of engineering standards at Buick Motors Corporation. Mr. Keller was connected with Buick for 25 years.

Tocco men promoted were: Dr. Harry B. Osborn, Jr., formerly Research and Development Engineer, to Sales Manager of the Tocco Division; John T. Vaughn to Dr. Osborn's former place as Research and Development Engineer while A. H. Pittaway becomes Laboratory Superintendent and John Gibbons, Office Supervisor. Tinkham Veale continues as head of the Production Engineering Department and A. O. Wood as Chief Engineer.

Creation of the Commercial Engineering Department amplifies Tocco's service facilities. The new section has a three fold responsibility of handling inquiries, making quotations, and planning all phases of basic engineering on induction equipment projects.

Chapman Named Vice President of Tams, Inc.

EDGAR OFFER, President of Tams, Incorporated, announced recently that John W. Chapman has been elected vice-president of the organization in charge of yacht brokerage and management. Mr. Chapman was recently released from the Navy with the rank of full Commander, after serving six years in the office



HALL Model EDP Diesel Type Valve Seat Grinder.

Ashore or afloat, diesels are expected to—and do—come through long hours of continuous operation—often under conditions no engine should be expected to successfully combat.

That's why diesel valve seats should be serviced with this HALL ECCENTRIC Grinder, designed to provide fast, easy restoration of original factory precision and finish.

Removing only enough of the valuable seat surface—hardened by heat and the continual hammering of the valve—it provides a round, true seat that requires re-servicing less frequently.

Complete information on the Model EDP Seat Grinder and HALL Wet Type Valve Refacer awaits your request.

THE HALL MFG. COMPANY
TOLEDO 7, OHIO

HALL

of Chief of Naval Operations, Washington, D. C. Mr. Chapman comes to Tams, Incorporated, with a background of over twenty years' experience in the yacht building and brokerage fields, all acquired prior to his entering the Naval service. He has been associated with such firms as Consolidated Shipbuilding Corporation, Cox & Stevens and the late Roger Haddock.

Tams, Incorporated, having now completed all of its Navy and War Department contracts, will resume full scale operations in the specialized business of naval architecture and marine engineering, yacht brokerage, yacht management and marine insurance brokers, rounding out fifty years of business on January 1.

Devin Appointed Manager Cooper-Bessemer Railway Div.

Fletcher M. Devin

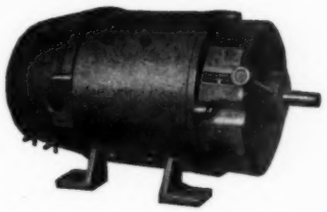
PROMOTION of Fletcher M. Devin on January 1st to the position of Manager of Railway Engine Division of The Cooper-Bessemer Corporation, has been announced by S. E. Johnson, vice president and director of sales.

The appointment is coincidental with the company's recent development of a new line of Diesels adaptable to locomotive service in sizes from 300 to 1600 horsepower.

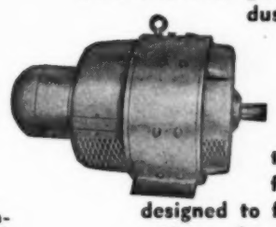
Mr. Devin has been associated with Cooper-Bessemer for the past 25 years, during which time his activities as sales engineer have extended into nearly every phase of the company's markets.

His activities in the new position will include development of mobile power units as well as their sale. Simultaneously, Mr. Devin becomes a member of the company's Operating Committee and will have a voice in the determination of all company policies.

GENERATORS AC and DC



Well-known for their rugged design, efficient performance, long life and minimum maintenance, whether powered by electric, gasoline, or Diesel equipment. Backed by over ½ century of manufacturing and designing experience, Kurz and Root generators are now serving industries throughout the world.



DC generator (left) two - bearings, self excited type. Can also be furnished with direct connected exciter. Both AC and DC generators can be furnished in the single bearing, flange-mounted type for special mounting requirements. Ball bearing construction is used throughout. Complete data upon request.

Illustrated are AC generators, only 2 of the many different types developed and designed to fit specific needs and applications. (upper left) two-bearing self-excited type; (lower right) two-bearing, direct connected exciter type.

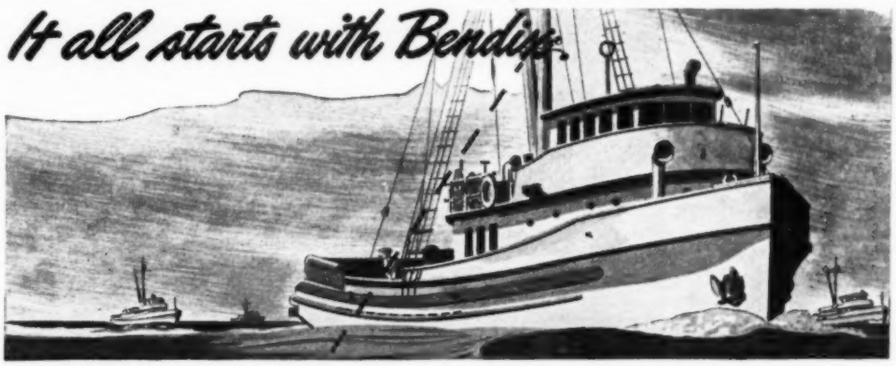
AC-DC GENERATORS

KURZ and ROOT Company Since 1898

APPLETON · WISCONSIN

.....and 20 meters and meter generator sets

It all starts with Bendix



Out of touch with land for months at a time, Diesel-powered commercial fishing craft must be "dead sure" of continuous dependable starting.

—and Bendix Starter Drives provide just that.*

Designed and engineered for compactness, ruggedness, universal adaptability, and simplicity of operation, these heavy-duty Drives have a performance-proven record of many years of dependable service on land and sea.

For heavy-duty Starting—marine, automotive and industrial—Bendix is best.

*REG. U. S. PAT. OFF.

Bendix Drive

ECLIPSE MACHINE DIVISION

Division of Bendix Aviation Corporation

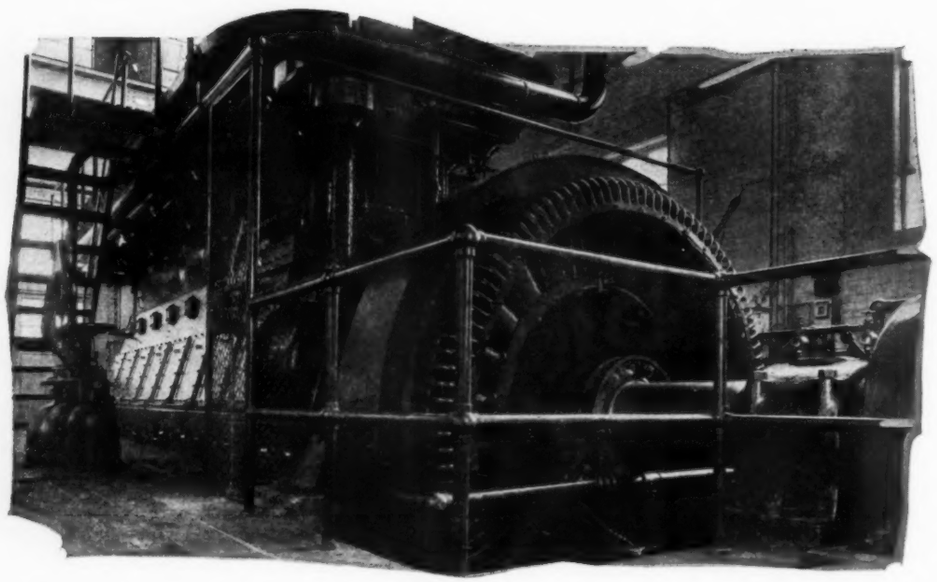
ELMIRA, NEW YORK

Bendix AVIATION CORPORATION

"8 YEARS

without an oil change

since switching to Tycol Diesel Oil"



"Sticking Valves eliminated...
Maintenance costs cut 15%...
Lubrication costs lowest on record..."

This is how leading engineers describe some of the advantages of Tycol Diesel Oil. This modern lubricant is refined by a special process which reduces sludge and carbon-forming compounds . . . assures peak performance at minimum cost.

For full information about the benefits of Tycol Diesel Oil, write, wire, or phone your nearest Tide Water Associated Office.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

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INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
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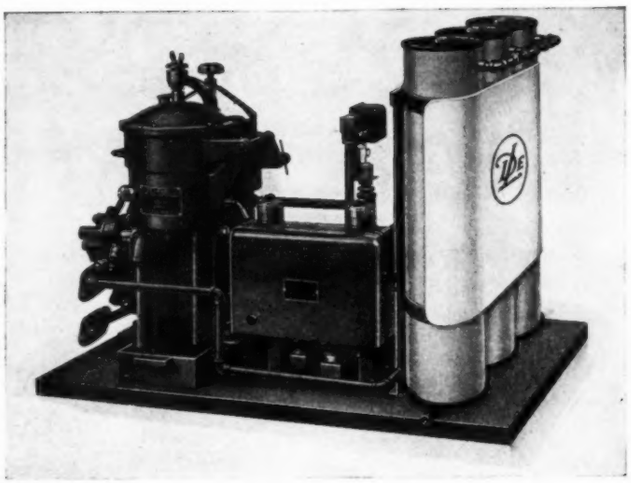
TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.



NEW-

DE LAVAL "PURI-FILTER"
FOR PURIFYING DIESEL LUBE OIL
Centrifugal Purification PLUS Micronic Filtration

Note these Features

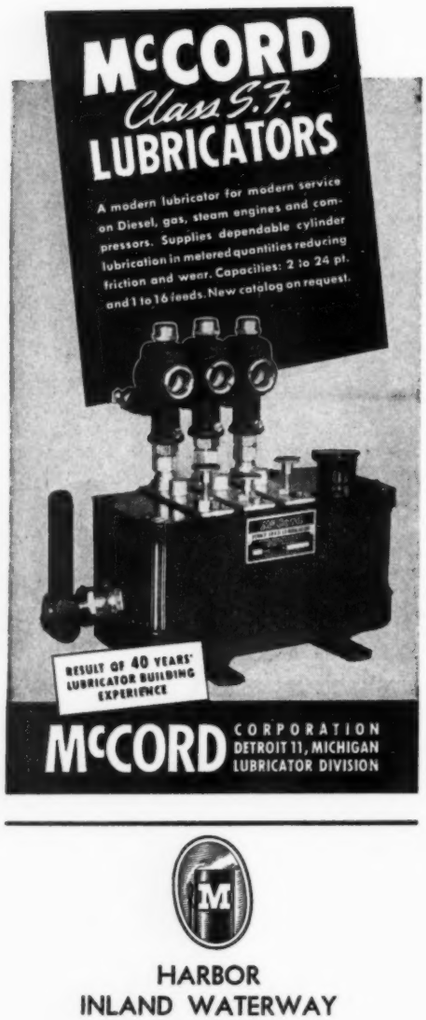
1. Removes dirt and water by centrifugal force
2. Filters out harmful carbon
3. Does not remove valuable additives
4. Cleans oil at moderate temperature
5. Speeds up inspection—crankcase is cleaner
6. Minimizes ring sticking
7. Increases bearing life
8. Saves labor—long runs without bowl cleaning
9. Increases oil life
10. No dirt . . . carbon . . . or water

THE De Laval "Puri-Filter" is a combination of the De Laval "Uni-Matic" Oil Purifier and the Fram "Filcron" Filter. The unit is complete with dirty-oil and clean-oil pumps, and is piped, ready to operate. Electrical controls are provided, and all parts are compactly mounted on a sturdy metal base.

The De Laval "Puri-Filter" enables the Diesel operator to secure the advantages of purifying Diesel lubricating oil by centrifugal force ***and*** by positive filtration. Heretofore he has been forced to choose between centrifugal force, which removed most solid impurities and all water, and filtration, which in cleaning the oil also restored a good measure of color, but which provided no protection against water. With the "Puri-Filter", Diesel lubricating oil can be maintained truly ***clean*** and ***dry***—the maximum in protection for every engine. Ask for Bulletin D-1.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
QUEBEC MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL OIL PURIFIERS
FOR DIESEL LUBRICATING OIL

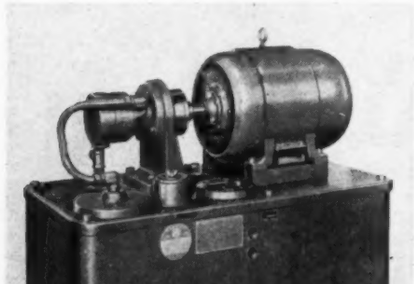

McCORD
Class S.F.
LUBRICATORS
A modern lubricator for modern service on Diesel, gas, steam engines and compressors. Supplies dependable cylinder lubrication in metered quantities reducing friction and wear. Capacities: 2 to 24 pt. and 1 to 16 feeds. New catalog on request.
RESULT OF 40 YEARS' LUBRICATOR BUILDING EXPERIENCE
McCORD CORPORATION
DETROIT 11, MICHIGAN
LUBRICATOR DIVISION

R. H. Huffman Appointed Division Manager for Atlas Diesel Engines

THE Atlas Imperial Diesel Engine Co. recently announced the appointment of R. H. Huffman as manager of its Central Division Offices at 228 North LaSalle Street in Chicago.

Prior to his association with the Atlas Company, Mr. Huffman was Regional Manager for the National Supply Company with headquarters in Chicago and District Offices in St. Louis and Ames, Iowa. In his new position with Atlas Diesel, he will have full supervision over sales, installation and service in the Mid-Western States.

New Hydraulic Units



Barnes model F-20-A hydraulic unit.

TWO bulletins issued by the John S. Barnes Corporation describe two new hydraulic units designed for a wide range of machine operations. The smaller unit has a capacity of 5 gpm. at 500 psi. while the larger unit will supply 12½ gpm. at 1000 psi. For further details request bulletins 303-U and 304-U from the John S. Barnes Corporation, Rockford, Illinois.

Columbia A.C. and D.C. Generators are built to meet highest performance standards. Complete range of application, including light, power, ship auxiliaries, or custom designed units.
D.C. UNITS range from 7½ to 200 KW.
A.C. UNITS range from 6¼ to 300 KVA.
Speeds and other specifications to meet requirements. Write for full information.
COLUMBIA ELECTRIC MFG. CO.
4519 Hamilton Ave., N.E., Cleveland 14, Ohio
COLUMBIA
GENERATORS
A.C. and D.C.

For more power and improved performance replace with
Jahns
QUALITY PISTONS
Jahns Quality Pistons are available in all sizes and types for diesel engines. There's a Jahns dealer near to give immediate attention to your requirements. Or write direct for complete information.
Jahns

Chicago Metal Hose Publishes New Compensator Bulletin

"COMPENSATORS are essentially flexible tube members designed to compensate for, or absorb motion inherent in, general pipe line installations. The flexible tube pressure carrying members of Chicago Metal Hose Compensators are one piece and all metal, manufactured in a range of diameters to serve a variety of pressure and motion requirements. C.M.H. Compensators, unlike most expansion joints, allow for motion in multiple planes as well as axial motion."

Thus, Chicago Metal Hose Corporation introduces its new compensator bulletin, which has just been completed and is now ready for distribution. In condensed text, the bulletin has been designed to present specifications and data for installation of C.M.H. Compensators. Write for Bulletin COM-1, Chicago Metal Hose Co., Maywood, Illinois.

Macy O. Teetor Resigns Perfect Circle Vice-Presidency

RALPH R. TEETOR, Perfect Circle President, announced recently that the management has accepted, with keen regret, the resignation of Macy O. Teetor, Vice-President in Charge of Engineering. His resignation became effective September 15, 1946.

Ill health, necessitating an extended period of recuperation, terminated the 23-year period of Mr. Teetor's active engagement in Perfect Circle management. He will continue to be connected with the company as a member of the Board of Directors and as an engineering consultant.

Daniel C. Teetor has been appointed Acting Vice-President in Charge of Engineering. This new duty has been assumed in addition to his present capacity as Vice-President in Charge of Manufacturing.

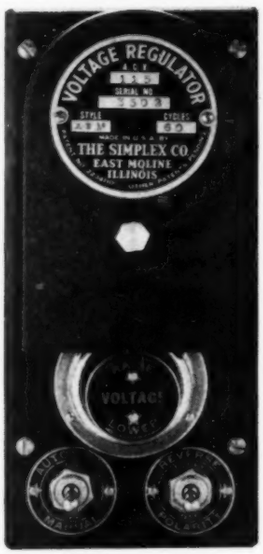
SIMPLEX VOLTAGE REGULATORS

Alternating current generator owners throughout the world find great satisfaction in using SIMPLEX VOLTAGE REGULATORS in regulating the voltage of A.C. generators—Large and small.

For over twelve years SIMPLEX has enjoyed an enviable position in the manufacture of fine voltage regulators.

Post war type SIMPLEX VOLTAGE REGULATORS are as revolutionary in the field of voltage regulators as the ATOMIC energy is in the field of munitions.

SIMPLEX VOLTAGE REGULATORS are sold under a guarantee of satisfaction. Buy the LATEST AND BEST—it even costs LESS.



Manufactured exclusively under the Debrey patents by

THE SIMPLEX COMPANY

EAST MOLINE, ILLINOIS
U. S. A.

UNITED STATES GAUGE

Tomorrow's accuracy is here today in the new U. S. Supergauge. Get complete information about this superb instrument now.

DIVISION OF AMERICAN MACHINE AND METALS, INC., SELLERSVILLE, PENNA.
Manufacturers of Pressure, Temperature, Flow and Electrical Measuring Instruments

USG

YOUR COMPETITORS WILL GREET YOUR CUSTOMERS AND PROSPECTS
IN THE CIVIC AUDITORIUM, SAN FRANCISCO, MAY 12th - 17th, 1947

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Second Annual

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FOR FULL INFORMATION ADDRESS
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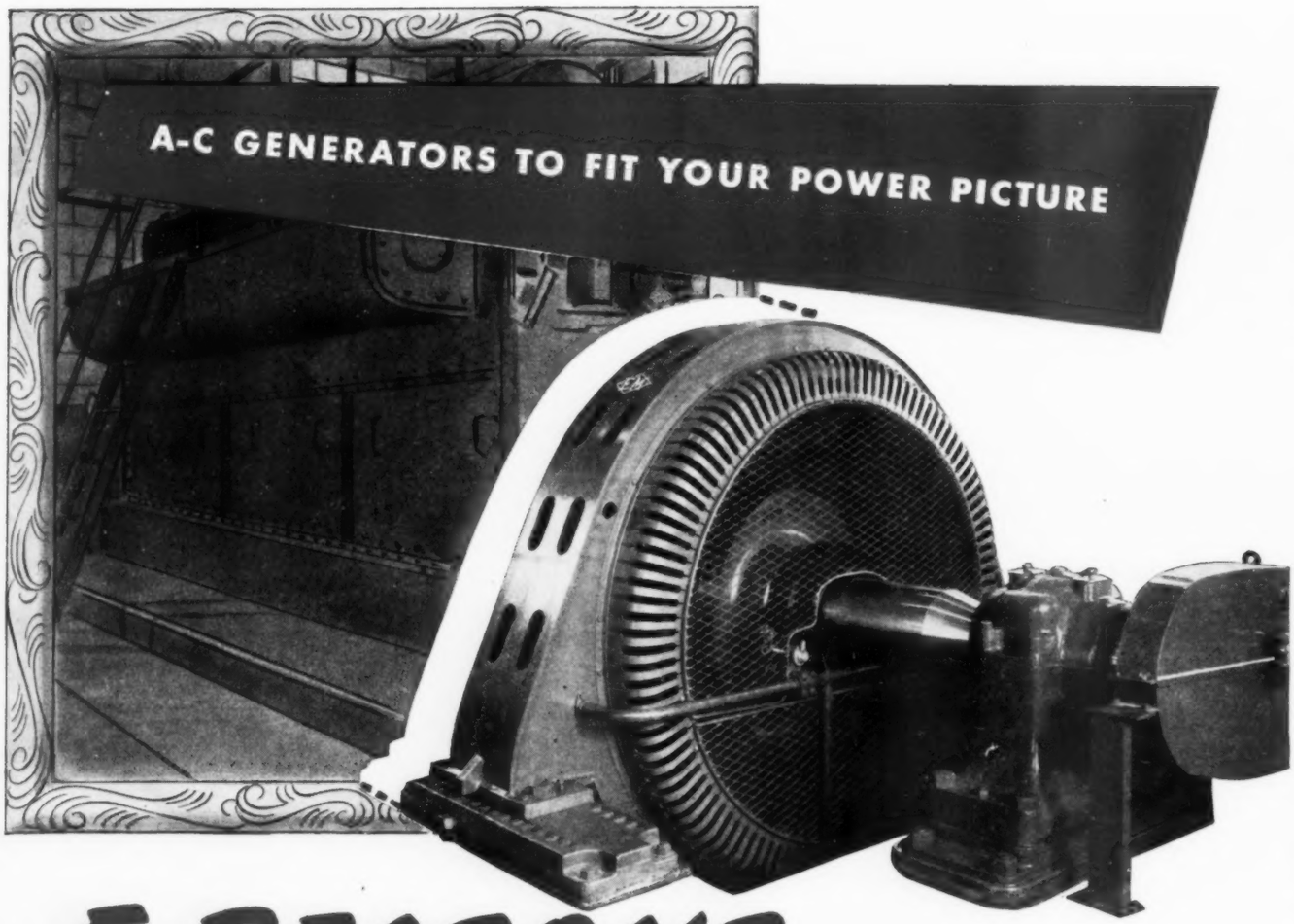


5 REASONS...

WHY E-M SYNCHRONOUS GENERATORS MEET ALL REQUIREMENTS

1. They're Dependable. This means unfailing performance, day after day, for years. It's the result of unsurpassed "know how," acquired through 42 years experience in generator design and construction.

2. They're Custom-Built to match your engine and power requirements. This results in highest operating efficiency in your plant and lowest cost per unit of power delivered.

3. They're Liberally Designed to provide ample capacity to meet emergencies without stress or strain. E-M Synchronous Generators remain cool-running and quiet, are easy-synchronizing, and have excellent paralleling qualities.

4. They're Attractive and lend modern distinction to your power plant. Pleasing appearance of generators usually goes hand-in-hand with good details of design.

5. They're Easily Installed and help to lower initial cost and to save time in completing assembly of your power plant units. Special E-M features permit easy, accurate generator adjustments and simple, low cost maintenance.

WRITE TODAY For Publication 185,
"Modern Power Plants Deserve E-M Generators"

● Describes the features which make E-M Engine-type Synchronous Generators so dependable for modern power plants. Attractively illustrated with more than 70 photographs and diagrams.

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13, Minnesota
Specialists in highest quality a-c generators since 1903

Sales & Engineering Offices in 32 Cities

GOOD POWER PLANTS DESERVE E-M GENERATORS

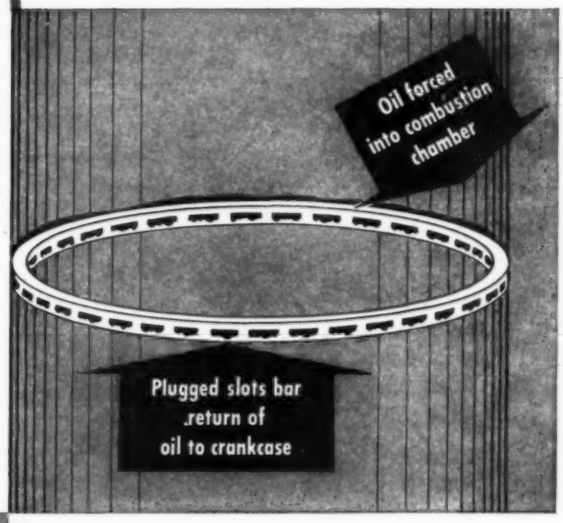
LOW SPEED | HIGH SPEED | ENGINE TYPE | "PACKAGED" | WATERWHEEL

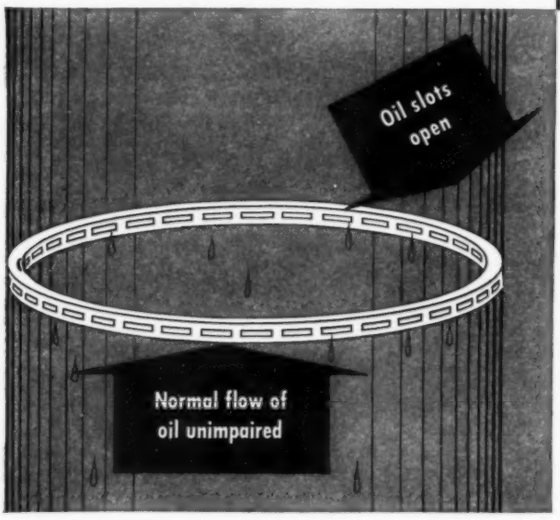
A3008

Diesel Engine DANGER points

Plugged Oil Slots Increase Oil Consumption

When carbon and gum formations clog oil-ring slots, the oil which would normally return through these apertures to the crankcase is forced into the combustion chamber. Here it joins the other products of combustion which "coke" on the ring belt area cementing the rings in their grooves and aggravating the clogged condition of the ring slots.





RPM DELO Oil keeps oil slots open, prevents stuck rings

RPM DELO Diesel Engine Lubricating Oil is compounded to prevent engine deposits these three ways:

1. An oxidation inhibitor reduces the formation of gummy particles which form the binder for carbon deposits.
2. A detergent prevents deposits forming on rings and pistons, keeping engines cleaner.
3. A dispersive agent insures removal of this material when the oil is drained.

Other compounds in RPM DELO Oil minimize hot-spot wear, prevent corrosion, eliminate foaming.

To match the fine performance of RPM DELO OIL, use these equally efficient companion products from the same famous "RPM" line—RPM HEAVY DUTY MOTOR OIL —RPM COMPOUNDED MOTOR OIL—RPM GEAR OILS AND LUBRICANTS—RPM GREASES. For additional information or name of your distributor, write any of the companies below:

STANDARD OF CALIFORNIA • 225 Bush St., San Francisco 20, California
THE CALIFORNIA COMPANY • 17th and Stout Streets, Denver 1, Colorado
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA OIL COMPANY • 30 Rockefeller Plaza, New York 20

DIESEL ENGINE RPM DELO LUBRICATING OIL

NEW GASKET MATERIALS!
Better Answers to Old and New Diesel Problems!

Here at Fel-Pro, new processing has widened the usefulness of many conventional materials, and new synthetics are revealing new possibilities in both gaskets and in the equipment on which they are used. For example, suppose you wanted new mechanical properties in a dielectric material, or an oil resisting gasket that retained resilience under new circumstances, or a packing that remained indifferent to new conditions of heat and pressure: ASK FEL-PRO! If it isn't already here, we'll develop it for you. Either way, it will pay to consult Fel-Pro . . . FELT PRODUCTS MFG. CO., 1522 Carroll Ave., Chicago, Ill.

FEL-PRO tect

With Sealing Materials, Gaskets, Packing, Sound- and Vibration-Dampeners, Washers, Specially Die-Cut, Treated and Fabricated by Fel-Pro.

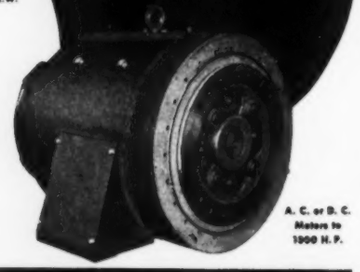
1040

CONSULT FEL-PRO!

50 YEARS OF GENERATOR EXPERIENCE-

Users and builders of smaller Diesel Engines find Burke Direct or Belt Drive Generators the answer to auxiliary and stand-by units for emergency lighting or power. Write Burke for recommendations. You profit by Burke's 50 years' experience.

A. C. or D. C. Generators to 1000 K.W.



A. C. or D. C. Motors to 1000 H.P.

BURKE ELECTRIC CO Erie, Pa.

Sterling Elects James D. Miller

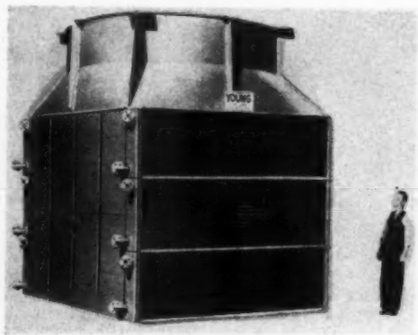
James D. Miller

FOLLOWING a recent board of directors meeting of the Sterling Engine Company, Addison F. Vars, president and general manager, announced the election of James D. Miller of New York to the company's board of directors.

Mr. Miller is nationally known in industrial and financial circles and brings to Sterling Engine a wealth of business experience that will prove most valuable to the planned activities of the company.

In addition to his Sterling directorship, Mr. Miller is actively engaged in the management of James D. Miller & Co., 140 Nassau Street, New York, N. Y., as senior partner of this, one of the country's oldest firms of certified public accountants.

New Large Capacity Cooling Radiators



Model VAD-10 vertical air discharge water cooling unit built by the Young Radiator Co.

A SERIES of new type large capacity cooling and condensing radiators was announced recently by the Young Radiator Company. The series has capacities ranging upward from 3,600,000 Btu./hr. at standard conditions. The cooling faces are located on two opposite sides of the unit to permit line installation of several

New DIESELS
Immediate DELIVERY

ENGINE GENERATORS
- 100 KW HERCULES
- 60 KW OIL WELL WEBER
- 40 KW HERCULES
- 30 KW GENERAL MOTORS
- 25 KW HILL
- 30 KW INTERNATIONAL
- 15 KW HERCULES

INDUSTRIAL ENGINES
- 75 HP CHRYSLER
- 9 HP WITTE
- 6 HP WITTE

MARINE ENGINES
- 165 HP GENERAL MOTORS 2:1, or 2.5:1, or 1:1.25
- 125 HP MACK-LANOVA 2:1
- 120 HP BUDA 2:1
- 125 HP HERCULES 1.5:1

WE BUILD TO ORDER

Wire, Write, or Phone Now!

Benjamin's for Motors
130 CLINTON STREET
BROOKLYN 2, NEW YORK
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THE EXPERIENCE

Resulting from a quarter century of repair work on all types of heavy industrial castings is available to you. Our specialty is the repair of Diesel heads . . . blocks . . . pumps . . . manifolds . . . water jackets. Ask about our exchange service to reduce your loss of operating time.

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GUTH WELDING WORKS
McPHERSON, KANSAS
Serving the Nation From its Center

Write for Bulletin

CHECK YOUR FUEL SUPPLY AT A GLANCE

THE LIQUIDOMETER CORP.

units where very large capacities are required, with no loss in efficiency or cooling faces blanketed off. The design can be used for water cooling, oil cooling, steam and vapor condensing, gas cooling or in combination arrangements to handle two or more types of service.

Following are some of the design developments incorporated into the VAD units: Vertical air discharge with an induced draft fan to obtain more even air distribution and eliminate recirculation and cross wind effects; low speed fan for efficiency operation with minimum horsepower costs; coils mounted in a vertical plane for economical installation, easy maintenance; fan and drive assembly mounted independent of main unit assembly, thereby eliminating the transmission of any vibration from moving to non-moving parts.

For further information concerning the VAD units write the Young Radiator Co., Racine, Wisconsin.

Bulletin Describes New Drilling Rig

THE Ideal Consolidated Rig Type 50 is fully described in a new bulletin just issued by The National Supply Company. The rig is constructed for fast and economical drilling to a nominal depth of 5000 feet and its six hoisting speeds and three rotary speeds with reverse give it great flexibility. The rig may be driven by two engines having combined maximum output up to 425 horsepower. The bulletin has twelve illustrations, a dimensional drawing, a shaft speed diagram, and gives complete engineering and operating specifications. It may be obtained by writing The National Supply Company, P. O. Box 899A, Toledo 1, Ohio, and asking for Bulletin No. 329.

Superdraulic Reduces Prices

HARRY L. WISE, president of the Superdraulic Corporation announced recently that the prices of his concern's products have been reduced an average of 20 per cent due to increased production and lower manufacturing costs. Mr. Wise stated further that a double guarantee of all Superdraulic products is soon to be announced.

MISOL

THE MILLER DIESEL FUEL ADDITIVE

THIS STARTLING NEW DISCOVERY GIVES YOU CLEAN FUEL SYSTEMS AND PEAK EFFICIENCY FROM TANK TO COMBUSTION CHAMBER.

SAFE AND ECONOMICAL

Descriptive Literature and full information on request

MILLER MANUFACTURING CO.
1100-1110 NORTH 32ND STREET CAMDEN, N. J.

It's still "D" Day for NATIONAL graduates

TODAY, more than a year after the war, National Graduates are still going "over the top" in the Diesel Industry.

True, most of them have swapped their G. I. clothes for a pair of Levi's, but, in nearly every country where Diesels operate, you'll find a representative group of National Graduates.

National Graduates hold high "priorities" on the list of personnel men for many different reasons. Perhaps one of the most important is the fact that National men are "hand-selected" *prior to training* by vocational advisors with long experience in judging a man's fitness for a given job.

Secondly, the National Training Program, as it stands today, is the result of more than *forty years* of concentrated effort on the part of our faculty, working hand in hand with industrial leaders to produce the kind of men industry expects.

ALL INCLUSIVE TRAINING

Then too, National's Training program is so all-inclusive; it teaches not only the technical "know-how" such as Fuel Injection, Engine Principles, Types, Construction, Lubrication and Cooling, Drive Systems, Auxiliary Equipment and all other important phases of the Diesel Engine field—but also actually includes many hours of *classroom instruction* in Character Building factors. These are the vital factors which make the difference between a mediocre employee and a willing co-worker!

During the four decades of our existence we have compiled some mighty interesting data regarding the average mechanically minded man. We know, from experience, how much to expect from him—how to develop and encourage him—how to bring to light his dormant creative abilities, making him a worthwhile investment for any employer!

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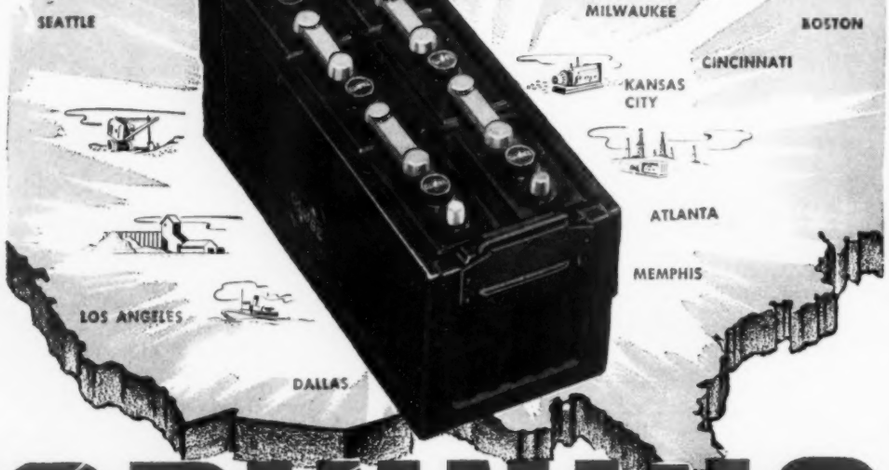
Federal Mogul Appoints M. J. Plawchan

H. F. DIXON, chief engineer of Federal-Mogul Corporation, announces the appointment of M. J. Plawchan as assistant chief engineer. Mr. Plawchan graduated from Michigan State College in 1935 with a degree in Mechanical Engineering. With Federal-Mogul Corporation since 1936, he has been in charge of all drafting room activities since 1942 and later as a design engineer. He is an active member of the Society of Automotive Engineers.

Informative Catalog Published By Fluor Corporation

RECENTLY published is the new Fluor catalog which describes all of the concern's manufactured products as well as outlining the engineering and construction services offered by them. Of greatest interest to the users of Diesels is the Fluor "fin-fan" Cooling unit for cooling jacket water or lubricating oil in locations where water is scarce. The fluid to be cooled is passed through finned tubes which are cooled by a propellor type fan. The section devoted to mufflers is also of interest. Fluor manufactures three different types suitable to Diesel application. Fluor's engineering and construction services are available to any client. The help which this service can give is valuable.

This catalog is available on request by writing the Fluor Corporation, Ltd., 2500 South Atlantic Boulevard, Los Angeles 22, California.



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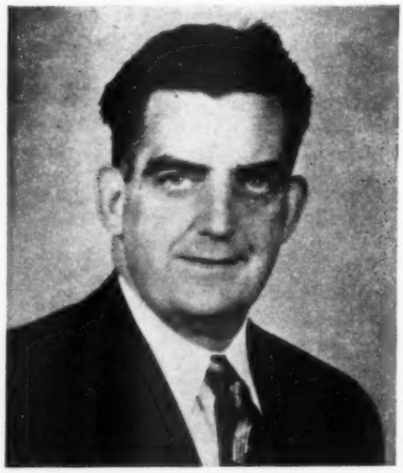

R. W. Hoyt

THE Double Seal Ring Company, Fort Worth, Texas, with branch factories in New York and Los Angeles, announces the appointment of R. W. Hoyt as Assistant Chief Engineer.

Mr. Hoyt is a mechanical engineering graduate of Purdue University, class of 1935. He has been employed eleven years by the Scintilla Magneto Division of Bendix Aviation Corporation, where he has been connected with the Diesel Fuel Injection Equipment program as Assistant Diesel Engineer.

New General Motors Field Service Officers Set Up For Locomotive Diesels

IN several moves to bring control of service and parts closer to railroads operating General Motors Diesel locomotives, Electro-Motive Division of General Motors recently announced establishment of a new Regional Field Service organization with headquarters in St. Louis and additional district representation, according to N. C. Dezendorf, Director of Sales and Service.

Milton H. Gardner, formerly Regional Service Manager at Chicago is now Regional Service Manager at St. Louis, reporting to G. E. Anderson, Regional Manager at St. Louis.

District representation has been restored at Ft. Worth, Texas, with R. H. Beight as District Engineer. A new district has been created to serve Mexican railways with San Luis Potosi, Mexico, as the center of operation. Mariano A. Montero is District Engineer. Denver Service headquarters has been transferred to the jurisdiction of the St. Louis region and will be in charge of District Engineer Gerald C. Smith.

Silicone Rubber Used For Diesel Gaskets

NEW applications for G-E silicone rubber as gaskets in high temperature equipment such as Diesel engines, gas turbines and air compressors have been announced by the General Electric Chemical Department. Engineers stated that the silicone gaskets are being incorporated between the supercharger and Diesel engine block in the new supercharged Diesel electric locomotive because of the positive gasketing action they provide at 300 F. and 15 pounds air pressure.

Advantages of the silicone rubber for these applications include its ability to remain soft and resilient at high operating temperatures, its low permanent set and its nonadherence to metals. The excellent heat resistance results in fewer replacements and less time lost due to repairs. Silicone rubber is also a good electrical insulator and has good arc resistance and non tracking characteristics. G-E silicone rubber remains practically unaffected when subjected to temperatures ranging from minus 55 F. to 520 F. It combines excellent moisture and chemical resistance and, because it does not contain sulphur in any form.

Answers to the problems on page 71

Card I 1. Injection is correct. Load is idling.
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Cards VII 1. Clogged arc cleaner.
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WEST COAST DIESEL NEWS

By FRED M. BURT

EACH powered with Kermath 250 hp., 6 cylinder Diesel engines, 45 ft. tugs *Sea Gull* and *Mogull*, left for Alaska to be used as utility tow boats, by Wingard Packing Co., just 30 days after Bryant's Marina, Seattle laid the keels. They were clocked at 18.6 knots in trial runs. Harold Lee, Seattle naval architect, designed the vessels.

THE Joshua Hendy Iron Works, Sunnyvale, Calif., has purchased the cast iron cylinder and engine base plant they operated during the war from the War Assets Administration for $1,103,295.

TWO contracts have been awarded to Tacoma firms for construction of trawler-seiner type fishing boats for UNRRA assignment to China to revive its fishing industry. Contracts from U. S. Treasury Procurement Div. to Tacoma Boat Bldg. Co.—9 boats; Pacific Boat Bldg. Co. —8 boats.

THE 82 ft. *Neptune* is the first steel seiner to join the Monterey fleet, Jerry Rodich, skipper; she is powered by two 320 hp. General Motors Diesel engines, carrying 22,000 gal. Diesel fuel for a cruising range of 18,000 miles. The auxiliary is a General Motors Diesel.

HARRY FURFORD is building a crab boat of his own on Salmon Bay, Seattle, from a 50 ft. Army J-boat, to be powered by a 100 hp. Buda Diesel engine.

THE last of a series of wood tuna clippers built by Campbell Machine Co., San Diego, the *Navigator*, 144 ft. 8 in. x 29 ft. x 16 ft. 9 in., is propelled by an 840 hp. supercharged, direct reversing Union Diesel engine; auxiliaries are

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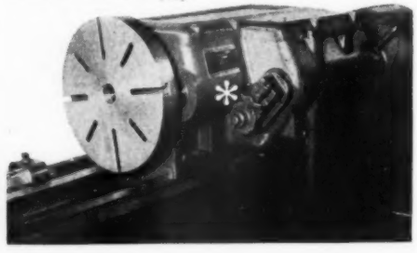

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SAN FRANCISCO'S famous Fisherman's Wharf is being expanded and altered to the tune of about $2,000,000. Ferry slips will be replaced by a pier 1315 ft. long, 155 ft. wide. A breakwater will protect the fishing fleet; a service station will be provided for fueling the boats.

DESIGNED and built by the Beviacqua brothers at the Genoa Boat Works, San Francisco, for Marco Carniglia, Monterey Bay fisherman, the *Five Brothers* is a versatile boat equipped for several kinds of fishing. 40 ft. x 12 ft. 6 in., she is powered with a Caterpillar 65 hp. Diesel engine, bought with accessories from Thomas A. Short Co., San Francisco.

A NINE hp. Sheppard Diesel engine with Twin Disc power takeoff to run a compressor for the refrigeration system, was purchased from Oswald Machine Works for shark boat *Virginia*, San Francisco.

DRIVEN by a 120 hp. Buda Diesel, the new 48 ft. Albacore boat *Kathie Jane*, built at Newport Beach, has gone into operation for Ralph Osterode. Supervision of the installation was by Nick Bobrick.

POWERED with 100 hp. Cummins Diesel engines, *Jody* the first, and several more new trollers to follow, built in San Francisco, will join the Northern California fishing fleet of Norcal Packing Co., Humboldt Bay. They will be equipped for salmon and crab fishing.

HENRY B. LANGE is a new special representative on the West Coast for Gray Marine Motor Co. He served in both World Wars and had his own consulting engineering organization in Los Angeles between them. Returning to California after the last war, he made a study of the marine field on the Coast for Gray, and then received this appointment.

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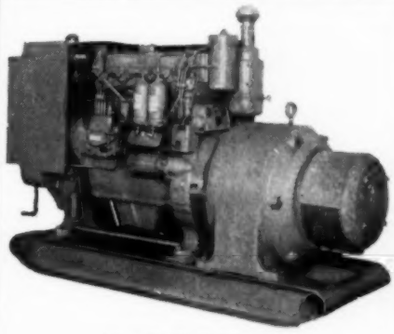

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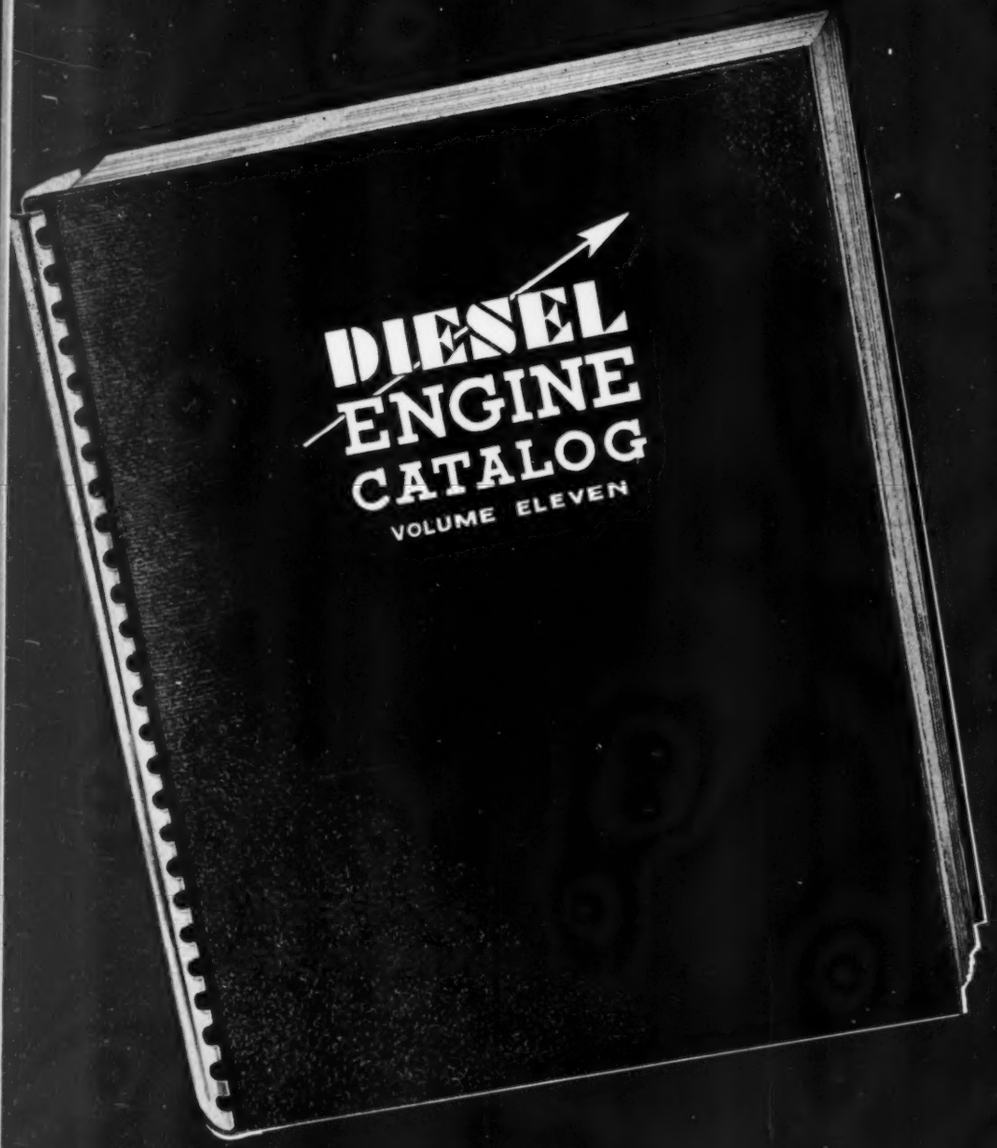

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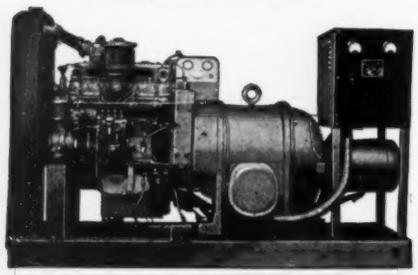

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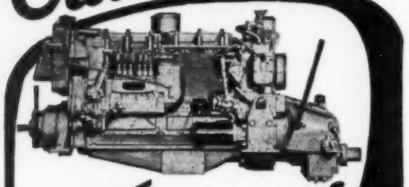

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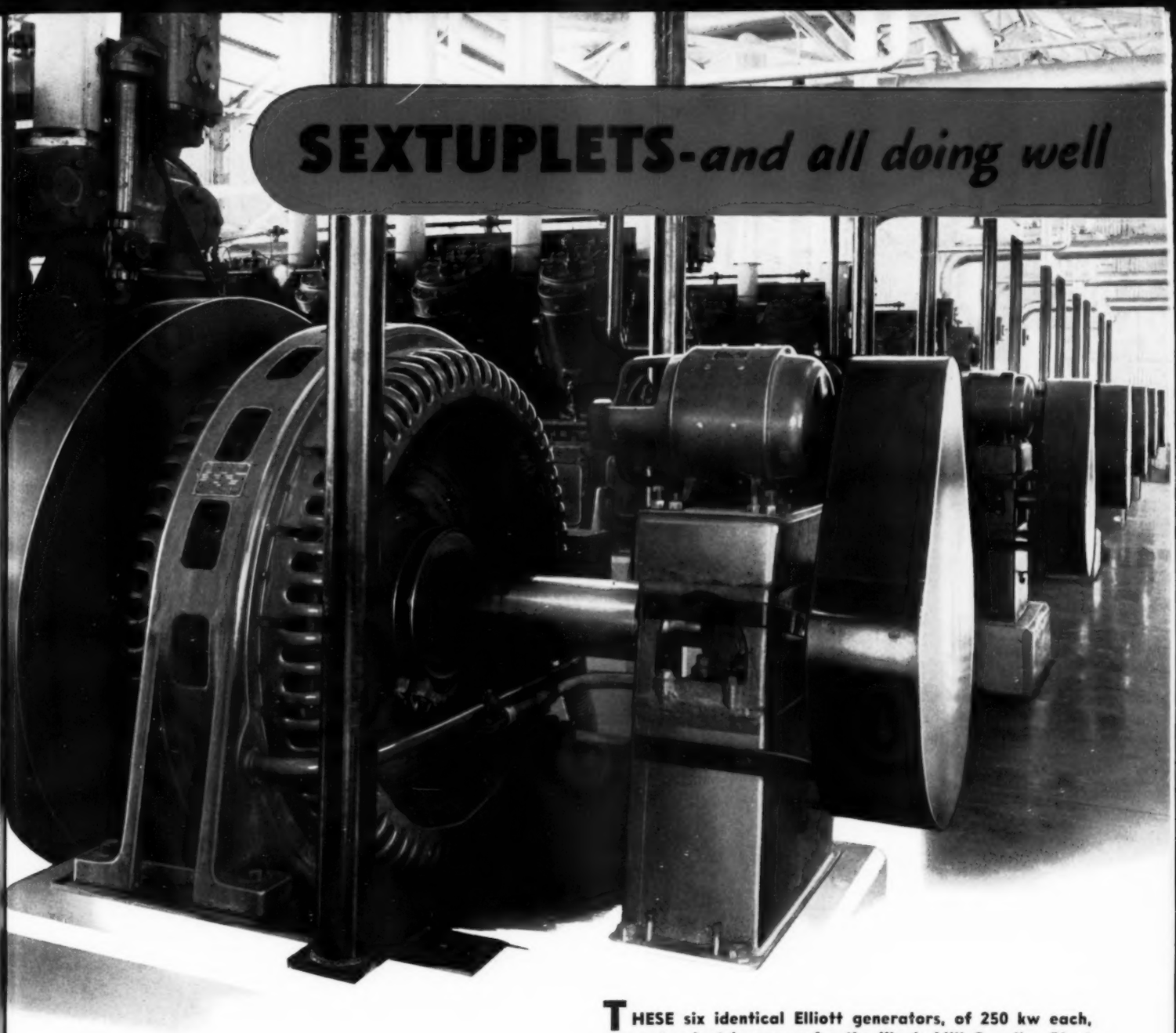

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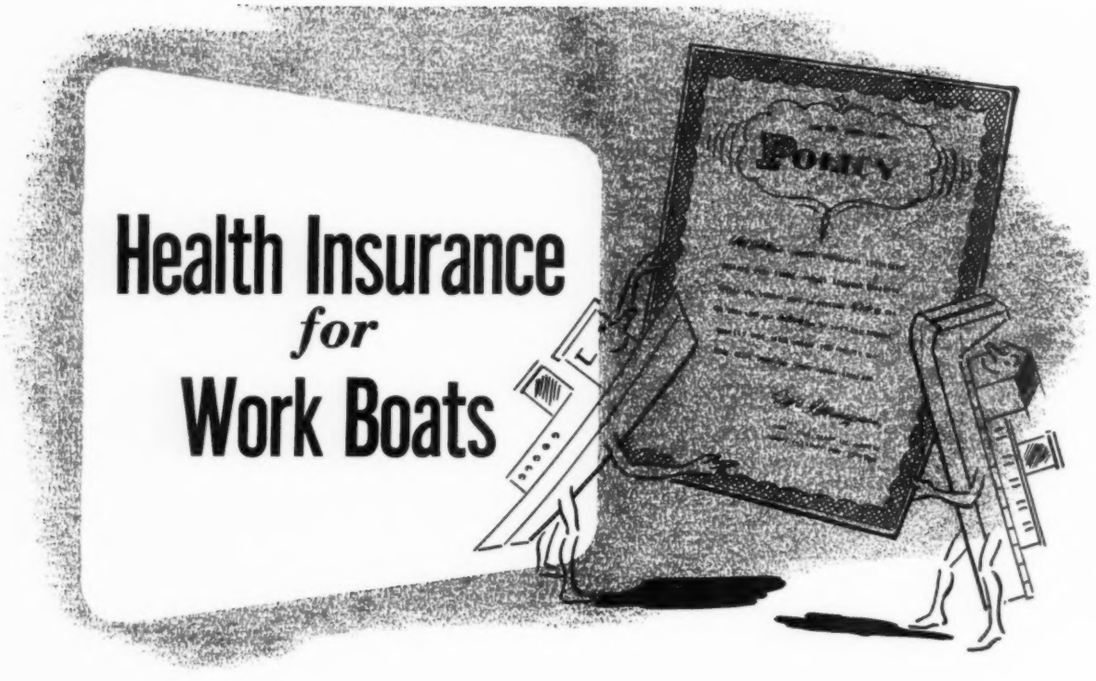
DO WELL WITH ANY DRIVE

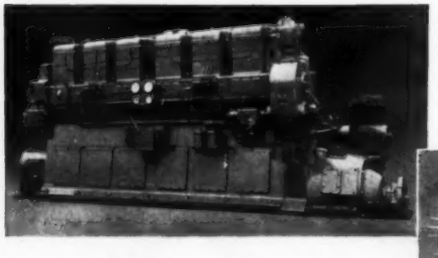
Health Insurance *for* Work Boats



THERE'S a good way to insure the health of that new work boat you're planning. This protection, effective for years, won't cost you a cent. In addition, you'll have full coverage on your boat's ability to take unexpectedly tough jobs in stride . . . without symptoms of pain!

This health insurance is one of the plus values you get when you install a Cooper-Bessemer diesel. Included are such benefits as Meehanite Metal for greater strength . . . unique, controlled-pressure fuel injection for economy and smooth operation at all speeds . . . turbu-flow oil cooling of pistons . . . modern, thin-wall precision-type bearings . . . full pressure lubrication . . . abundant reserve power for emergencies . . . and a raft of other benefits just as desirable.

They all add up to the best possible insurance that your Cooper-Bessemer powered work boat will stay healthy for years, always giving you top flight performance.



One of six Cooper-Bessemer marine diesel types, available atmospheric or supercharged up to 1,800 horsepower.

THE
Cooper-Bessemer
CORPORATION
Mt. Vernon, Ohio — Grove City, Pa.

New York, Washington, Gloucester, Dallas, Houston, St. Louis, Los Angeles, Seattle, San Francisco, and the Calmes Engineering Company, New Orleans, La.

BUILDERS OF DEPENDABLE ENGINES FOR 112 YEARS